DEFENSE TECHNOLOGY OBJECTIVES OF THE JWSTP AND DTAP

January 1997

DTOs

Defense Technology Objectives

of the

Joint Warfighting Science and Technology Plan

and the

Defense Technology Area Plan

January 1997

DEPARTMENT OF DEFENSE
DIRECTOR, DEFENSE RESEARCH AND ENGINEERING

CONTENTS

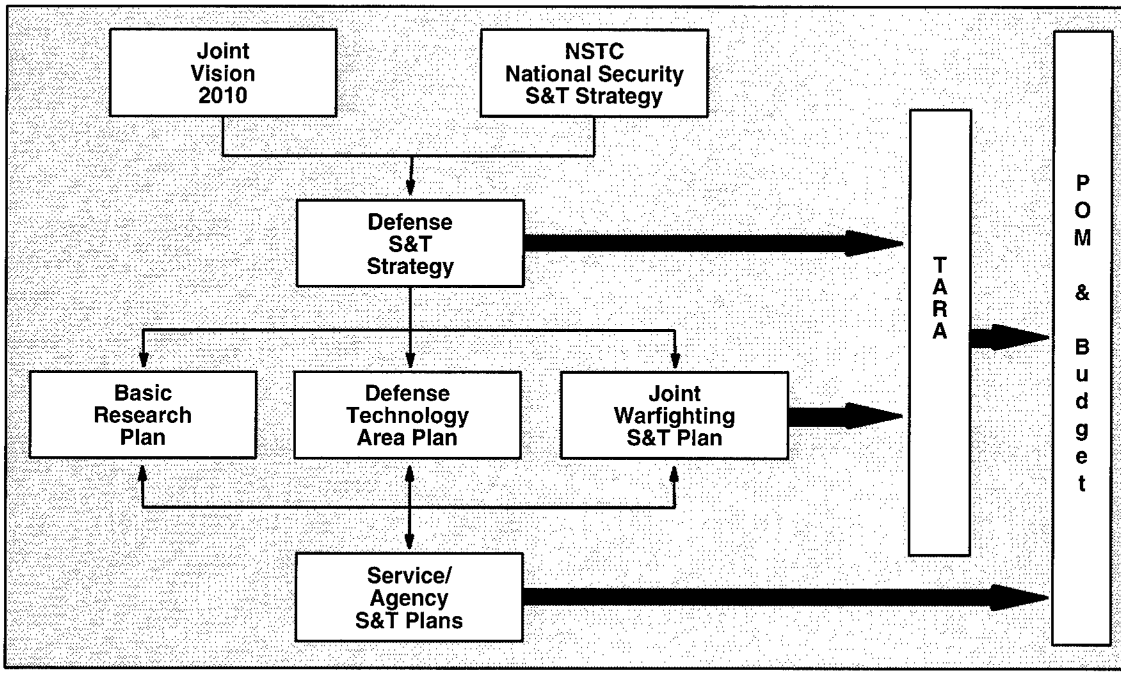
INTRODUCTION AND SUMMARY

Technological superiority has been, and continues to be, a cornerstone of our national military strategy. Technologies such as radar, jet engines, nuclear weapons, night vision, smart weapons, stealth, the Global Positioning System, and vastly more capable information management systems have changed warfare dramatically. Today's technological edge allows us to prevail across the broad spectrum of conflict decisively and with relatively low casualties. Maintaining this technological edge has become even more important as the size of U.S. forces decreases and high-technology weapons are now readily available on the world market. In this new environment, it is imperative that U.S. forces possess technological superiority to achieve and maintain the dominance displayed in Operation Desert Storm. The technological advantage we enjoy today is a legacy of decades of investment in science and technology (S&T). Likewise, our future warfighting capabilities will be substantially determined by today's investment in S&T.

In peace, technological superiority is a key element of deterrence. In crisis, it provides a wide spectrum of options to the National Command Authorities and commanders in chief, while providing confidence to our allies. In war, it enhances combat effectiveness, reduces casualties, and minimizes equipment loss. In view of declining defense budgets and manpower reductions, advancing military technology and ensuring that it undergoes rapid transition to the warfighter are national security obligations of ever greater importance.

To fulfill these obligations, the Director, Defense Research and Engineering (DDR&E), has continually enhanced the strategic planning process for defense S&T. The foundation of this process is the *Defense Science and Technology Strategy* with its supporting *Basic Research Plan* (BRP), *Joint Warfighting Science and Technology Plan* (JWSTP), and *Defense Technology Area Plan* (DTAP) (References 1-4). These documents present the DoD S&T vision, strategy, plan, and objectives for the planners, programmers, and performers of defense S&T.

These documents are a collaborative product of the Office of the Secretary of Defense (OSD), Joint Staff, military services, and defense agencies. The strategy and plans are fully responsive to the National Security S&T Council's *National Security Science and Technology Strategy* (Reference 5) and the Chairman of the Joint Chiefs of Staff's *Vision* and *Joint Vision 2010* (JV 2010) (Reference 6), as shown in Figure 1. The strategy and plans and supporting individual S&T master plans of the military services and defense agencies guide the annual preparation of the defense program and budget. The strategy and plans are made available to the U.S. Government, defense contractors, and our allies with the goal of better focusing our collective efforts on superior joint warfare capabilities and improving interoperability between the United States and our allies.



Defense Science and Technology Strategy (Reference 1). The *Defense Science and Technology Strategy* is responsive to the Secretary of Defense's vision to "develop and transition superior technology to enable affordable, decisive military capability."

The strategy focuses on four generic considerations that have high priority in making strategic decisions about which technologies are pursued:

- *Affordability*. Where appropriate, S&T projects must focus on increasing the effectiveness of a capability and decreasing cost, increasing operational life, and incrementally improving material through planned upgrades.
- *Dual Use*. The S&T program must contribute to building a common industrial base by using commercial practices, processes, and products, and by developing, where possible, technology that can be the base for both military and commercial products and applications.
- *Accelerated Transition*. Advanced Concept Technology Demonstrations (ACTDs) are a key element in the S&T program to focus science and technology on supporting military needs and problems, expediting transitions, and providing a sound basis for acquisition decisions.
- *Strong Technology Base*. The technology base generates DoD's legacy to tomorrow's warfighter. Accordingly, it is imperative to maintain a stable technology base investment to develop options for the truly long term—beyond the threats, situations, and budgets that we can predict.

Basic Research Plan (Reference 2). The BRP presents the DoD objectives and investment strategy for DoD-sponsored Basic Research (6.1) performed by universities, industry, and service laboratories. In addition to presenting the planned investment in

each of 12 technical disciplines composing the Basic Research Program, the plan highlights six strategic research objectives holding great promise for the development of enabling breakthrough technologies for revolutionary 21st century military capabilities.

- Biomimetics
- Nanoscience
- Smart structures
- Mobile wireless communications
- Intelligent systems
- Compact power sources

The coupling of the BRP with the DTAP and the JWSTP is carried out in several ways. First, the planning stage of the 12 individual research areas has the active participation of both the Service Laboratories and the Warfighters (through the Operating Commands, such as the Army's TRADOC). This activity takes place by providing requirements and, oftentimes, serving on planning committees that focus on or include basic research. Second, representatives of the Service Laboratories and Operating Commands also take part in the program evaluation process through attendance and participation in Service S&T program reviews and the ODDR&E TARA reviews.

Joint Warfighting Science and Technology Plan (Reference 3). The JWSTP takes a joint perspective horizontally across the Applied Research (6.2) and Advanced Technology Development (6.3) plans of the services and defense agencies to ensure that the requisite technology and advanced concepts for superior joint and coalition warfighting are supported. It ensures that the near-, mid-, and long-term needs of the joint warfighter are properly balanced and supported in the S&T planning, programming, budgeting, and assessment activities of the DoD. The JWSTP is focused around 10 Joint Warfighting Capability Objectives (JWCOs). These objectives support the Joint Warfighting Capability Assessment (JWCA) and the four operational concepts emphasized in JV 2010: dominant maneuver, precision engagement, full-dimension protection, and focused logistics. A significant feature of the JWSTP is the identification of mechanisms for the timely transition of technology to the warfighter in the field before it becomes obsolete or falls in the hands of our adversaries.

Defense Technology Area Plan (Reference 4). The DTAP presents the DoD objectives and the Applied Research (6.2) and Advanced Technology Development (6.3) investment strategy for technologies critical to DoD acquisition plans, service warfighter capabilities, and the JWSTP. It also takes a horizontal perspective across the service and defense agency efforts, thereby charting the total DoD investment for a given technology. The DTAP documents the focus, content, and principal objectives of the overall DoD science and technology efforts. This plan provides a sound basis for acquisition decisions and is structured to respond to the DDR&E emphasis on rapid transition of technology to the operational forces. This year the DTAP includes an assessment of the potential technology capabilities of other countries vis-à-vis the United States.

Defense Technology Objectives (Reference 7). The focus of the S&T investment is enhanced and guided through Defense Technology Objectives (DTOs). Each DTO identifies a specific technology advancement that will be developed or demonstrated, the anticipated date of technology availability, and the specific benefits resulting from the technology advance. These benefits not only include increased military operational capabilities but also address other important areas, including affordability and dual-use appli-

cations, that have received special emphasis in the *Defense Science and Technology Strategy.* Each DTO also identifies funding required to achieve the new capability. This funding, shown in millions of dollars, has been rounded to a single decimal, so all totals in the tabulations may not add due to rounding.

This document contains descriptions of nearly 300 DTOs. Two-thirds of these are identified in the DTAP, which cites the anticipated return on the S&T investment through 10 broad technology areas. The remaining DTOs support the 10 JWCOs of the JWSTP. JWSTP DTOs are limited to Advanced Technology Demonstrations (ATDs) and Advanced Concept Technology Demonstrations (ACTDs).

The DTOs are presented in a separate volume in two parts—one for the DTAP and one for the JWSTP. The DTAP DTO number consists of a two-letter prefix corresponding to the names of the 10 technology areas addressed in that document, a two-digit numeral that represents the DTO sequence, and a second two-digit numeral that is an undefined field. The letter prefix for the JWSTP DTO number corresponds to the 10 sections (A through J) in Chapter IV of that document, followed by a two-digit sequence number. Thus, DTO numbers easily distinguish JWSTP from DTAP DTOs. The DTO sequence numbers do not connote priorities.

The JWSTP and the DTAP document the focus, content, and principal objectives of the overall DoD technology efforts (budget categories 6.2 and 6.3). These plans are presented in separate documents under their respective titles.

This document concludes with an appendix that is a compilation of all abbreviations and acronyms used in the JWSTP and DTAP as well as in these DTOs.

References

1. *Defense Science and Technology Strategy*, Director of Defense Research and Engineering, September 1994
2. *Basic Research Plan*, Director of Defense Research and Engineering, January 1997
3. *Joint Warfighting Science and Technology Plan*, Director of Defense Research and Engineering, January 1997
4. *Defense Technology Area Plan*, Director of Defense Research and Engineering, January 1997
5. *National Security Science and Technology Strategy*, National Science and Technology Council, 1995
6. *Joint Vision 2010*, Joint Chiefs of Staff, 1996
7. *Defense Technology Objectives of the Joint Warfighting Science and Technology Plan* and the *Defense Technology Area Plan*, Director of Defense Research and Engineering, January 1997

SECTION I

JOINT WARFIGHTING SCIENCE AND TECHNOLOGY PLAN

DEFENSE TECHNOLOGY OBJECTIVES

INFORMATION SUPERIORITY

INFORMATION SUPERIORITY

A.02 ***Robust Tactical/Mobile Networking.*** This DTO's two component programs are the Warfighter's Internet and the Airborne Communications Node (ACN) along with supporting Army Tech Base programs. The goal of the Warfighter's Internet is to develop and demonstrate rapidly deployable, highly adaptive network services and end-to-end quality-of-service management to deployed warfighters. Technology development and demonstration will focus on networking technologies to integrate across existing and developmental communication systems and networks using an airborne node such as the ACN as the basic architecture. The ACN goal is to develop a payload based on Speakeasy technology—the Joint Airborne Signals Intelligence Architecture for deployment on the Global Hawk High-Altitude Endurance Unmanned Aerial Vehicle. ACN will establish a robust communications infrastructure to match the requirements of military operations, including prehostility, en route, and early entry without large in-theater assets, through the lifetime of a conflict. Both programs will conclude with joint integrated field demonstrations in FY00. DARPA (GloMo) and Army (Digital Battlefield Communications (DBC) ATD and Range Extension Program) technology base programs will provide feeders for this DTO. The Army is developing technologies for heterogeneous, high-data-rate communications (DTO IS.23 and IS.20), including the Radio Access Point (RAP), which is part of the DBC ATD. Protocols and network management technology will be developed for the Warfighter's Internet and integrated to establish a self-aware and self-managed intelligent backbone with moving airborne network nodes, cross-linked to SATCOM and wireless terrestrial backbone nodes, including DBC RAP. The Global Hawk, at 65,000-ft altitude, provides line-of-sight extension up to a 150+ mile radius for ground-based forces and up to a 300+ mile radius for airborne forces. ACN connects isolated and rapidly maneuvering forces, provides reachback connectivity to CONUS from forward elements, and provides connectivity among similar and dissimilar radios through relays and gateways. The Range Extension project will provide an SHF full-duplex connectivity with a remote mobile location using an airborne hub switching among a minimum of four terrestrial terminals at T-1 rates. The DBC ATD Airborne Relay will demonstrate an X-band, DS–3 (45 MB/s total transponder bandwidth) UAV payload.

Program payoffs include responsive backbone projection into the tactical area; we can expect to be able to project a Bosnia-size capability within 1 day and a Desert Storm-size capability within 2 days. The program will demonstrate the ability to insert additional relays and automatically reconfigure the backbone and end-to-end routing. End-to-end throughput enhancement will enable the achievement at least one order of magnitude improvement in end-to-end delivery time for wideband imagery products, with delivery to deployed mobile users. The program will demonstrate potential improvements over the current DISN-to-MSE-to-SINCGARS Tactical Internet information flows. The capability in this DTO is required to supply the communications infrastructure to meet the ABIS requirement of collaborative situation assessment and planning for forces en route and on the move.

Milestones for Warfighter's Internet include a lab/simulator demonstration of self-organizing airborne backbone (FY98), an initial airborne backbone demonstration with Global Hawk (FY99), and transition to services (FY01). Milestones for ACN include a communications and payload demonstration (FY98), a receiver/transmitter antenna delivery and a Global Hawk systems integration and test (FY99), and the system integration of Global Hawk and a full-field demonstration (FY00).

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603760E	CCC-02	9.3	25.2	30.0	30.0	30.0	0	0
0602702F	4519	0.3	0.8	0.6	0	0	0	0
0602782A	AH92	1.0	1.3	0	0	0	0	0
0603006A	D247	0.5	2.2	4.0	0	0	0	0
0603006A	D257	1.2	0.5	0.5	0	0	0	0
	Total	12.3	30.0	35.1	30.0	30.0	0	0

A.03 ***Joint Power Projection/Real-Time Support (Navy)/Rapid Force Projection Initiative Command and Control TD (Army).*** This two-part DTO encompasses two different projects—the first for the Navy and the second for the Army.

Joint Power Projection/Real-Time Support (Navy). C^4I-for-the-Warrior requires advanced technologies in achieving a real-time decision-making capability. Operation Desert Storm and subsequent joint exercises have revealed shortfalls in integrating mission planning, strike coordination and execution, and battle damage assessment between a naval force and a larger joint command structure. To help remedy these shortfalls, the Joint Power Projection/Real-Time Support (JPP/RTS) program is primarily concerned with technologies that will support an afloat commander, Joint Task Force, or Joint Maritime Component Commander by providing the capability to achieve (1) coordination of weaponeering, targeting, asset route allocation, weapon target allocation, and rapid interactive planning among staffs and warfighters in theater both ashore and afloat; (2) generation and preview, approval, rehearsal, and execution of complex TACAIR and cruise missile plans; (3) automated in-flight, in-cockpit mission management capabilities including threat updates, retargeting, rerouting, improved situation assessment, and offensive and defensive management capabilities; and (4) real-time information processing among planning, rehearsal, and execution workstations to improve use of tactical intelligence and enhance timeliness of mission planning and execution. JPP/RTS will demonstrate the ability to pull imagery, video, and text information needed for target analysis; cue and monitor reconnaissance assets; fully exploit the consistent tactical picture across planning nodes; develop power projection concepts and optimized attack plans with computer assistance across the entire power projection planning spectrum (ship-to-shore-to-ship); provide distributed preview and briefing of a force-level power projection plan; monitor force-level execution; provide force-level plans to unit-level planners for execution and evaluation; direct target changes with in-cockpit planning capabilities; and extract battle damage assessment (BDA) and mission information from returning strike team aircraft for a rapid follow-on strike.

In FY98, the program will demonstrate a 622-megabit/second shipboard local area network (LAN) prototype with interfaces to global and theater-level network control and management. The LAN will provide ATM network management and host advanced Navy/joint power projection tools on fleet workstations and host shipboard interior communications and advanced multimedia distribution. In FY99, the goal is to conduct a major integrated demonstration of planning and execution capabilities, including flight demonstration, in conjunction with Air Force (Joint Forces Air Component Commander ACTD) battle management, national intelligence, and battlefield visualization demonstrations. The program also will demonstrate OC–48 ATM trunks with advanced high-speed transport protocols and advanced congestion management.

Rapid Force Projection Initiative Command and Control TD (Army). Rapid reaction ground forces must by their very nature forego the availability of heavy armor support, yet they must be capable of defeating an enemy armored attack launched against them. It is essential that the early entry ground force be able to disrupt and defeat the enemy armor force before that force can bring its direct fire strength to bear. The RFPI C^2 TD program will develop a Light Digital Tactical Operations Center (LDTOC), which will demonstrate semiautomated target transfer from forward sensors (hunters) to weapon systems (standoff killers) using C^3 integration, and will facilitate fully exploring the capability to expand the brigade-level battlespace through the use of simulations and U.S. Army Training and Doctrine Command (TRADOC) Battle Lab Warfighting Experiments (BLWEs) and demonstrations. Real-time to near-real-time C^3 integration mechanisms will be compatible with U.S. Army Battlefield Operating Systems (BOS) (e.g., AFATDS, Light TACFIRE, ASAS). Finally, the LDTOC will provide the ability to conduct

essential targeting and intelligence collection using forward sensors and real-time communications to provide for precision engagements against a variety of high-priority targets, including armored vehicles.

The RFPI C^2 TD will deliver a Light Digital TOC Simulator (LDTOC SIM), a Light Digital TOC (LDTOC), and the appropriate C^2 enhancement and communications processing software. The initial build of the LDTOC SIM will be used during the BLWE to be conducted by the Dismounted Battlespace Battle Lab (DBBL) at Ft. Benning during the first quarter of 1997. The LDTOC-SIM is a stationary tabletop configuration located in a Land Warrior Testbed building at Ft. Benning. It will consist of RFPI unique workstations containing C^2 enhancement software, appropriate BOS, a LAN, and a communications processor to integrate the RFPI wide area network with the LAN. It will replicate early entry force brigade/battalion TOC operations in a simulated tactical environment and will provide a mechanism for the DBBL to refine LDTOC requirements

The LDTOC SIM, with improvements made as a result of the BLWE, will be used as the blueprint for the LDTOC, which will have ruggedized RFPI components. After a fourth quarter FY97 proof-of-principle exercise in which both the LDTOC SIM and the LDTOC will participate, both systems will participate in the RFPI ACTD, a third quarter FY98 full field exercise involving XVIII Airborne Corps. Following the ACTD, the LDTOC SIM will remain at DBBL while the LDTOC will be refurbished and will remain with the exercise unit to function as that unit's go-to-war TOC for a 2-year evaluation period.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603794N	X0291	16.4	15.7	16.9	17.1	17.3	17.7	17.9
0603772A	D101	4.0	2.1	0	0	0	0	0
	Total	20.4	17.8	16.9	17.1	17.3	17.7	17.9

A.04 ***Information Operations C^2*****.** The goal of this DTO is to develop, integrate, and demonstrate advanced real and surrogate C^2 systems against modern tactical information systems. The program will develop and demonstrate the ability to remotely affect advanced military communication networks for ground and airborne platforms. The DTO will be an initial prototype surveillance network for a selected set of computers and communications, using existing firewalls, mail guards, MLS guard, and the like as surveillance nodes. It also will demonstrate the ability to monitor and display near-real-time status in the form of events tracks and estimates, equivalent to an operational situation display. The program will establish and demonstrate mechanisms to incorporate surveillance information into the network management system in order to provide the technical foundation for planning to integrate battle management C^4I systems. These capabilities will be obtained and demonstrated through the use of advanced modeling, simulation, and laboratory experimentation as appropriate.

By FY98, the program will use advanced real/surrogate C^2 systems against modern target systems, leverage ongoing programs and developments, emphasize strategies used in field and lab environments, and identify C^2 protect hardware/software fixes for the Tactical Internet. In FY99, the program will demonstrate countermeasures against communication/navigation systems. The FY00 goal is to demonstrate electronic support and electronic strategies to counter modern telecommunication technologies.

This DTO serves as a supporting DTO to JWSTP DTO A.12.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603270A	DK15	0	0.4	1.4	6.5	6.2	2.5	0
	Total	0	0.4	1.4	6.5	6.2	2.5	0

A.05 ***Integrated Collection Management ACTD.*** The goal of this DTO is to develop an ACTD that demonstrates integrated collection management (ICM) of signals intelligence (SIGINT) and imagery intelligence (IMINT) national and theater sensors to optimize collection for the Joint Task Force (JTF). Other platforms and sensors will be included in the planning process for later insertion. The ACTD will address collection management for integration of national and airborne systems at the JTF level, provision of tasking-level data and status feedback to the JTF, dynamic integrated tasking of sensors from all-source strategies and cross-cueing of collection assets, and tasking inside friendly and enemy operating cycles (less than 24 hours, goal of 2–4 hours). Measures of merit will be based on establishment of assured collection for support to operations (routine use of intelligence, surveillance, and reconnaissance (ISR) data in operational planning; accuracy and timeliness of tasking, status, and feedback data; impact of improvements on operational tasks (more timely/accurate geolocation for strike operations, etc.); and more accurate situation awareness of operational and collection nodes). The JSEAD T&E program at Nellis AFB will be used to provide metrics for baseline and improve architectures for reactive SEAD operations. The intent is to include ICM ACTD as an enhancement to the baseline.

The ACTD will provide an initial capability for dynamic retasking and will concentrate on space and airborne collection of imagery and SIGINT. Provisions will be made for other integrations and other platforms to be added in the future. The first prototype will be completed at the end of FY97. The second prototype will be completed in the second quarter of FY98. Final delivery of the system is planned for the fourth quarter of FY99.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603750D	P523	0	1.0	1.0	0	0	0	0
	Total S&T	0	1.0	1.0	0	0	0	0
0305884L*	010012	1.4	1.4	1.5	0	0	0	0
TBD*		6.6	7.5	5.5	0	0	0	0
	Total	8.0	9.9	8.0	0	0	0	0

* Non-S&T funds.

A.06 ***Rapid Battlefield Visualization ACTD.*** The goal of this ACTD is to demonstrate and leave behind the ability to rapidly collect source data and generate high-resolution digital terrain databases to support crisis response and force projection operations. The timelines identified by the warfighter are a 20 x 20 km area in 18 hours, 90 x 90 km in 72 hours, and 300 x 300 km in 12 days. The Rapid Battlefield Visualization (RBV) ACTD also will demonstrate capabilities for the commander to integrate these terrain databases with current situation data. This integration will permit manipulation and display of the integrated databases to determine how to achieve the JTF's objectives and visualize the desired end state.

The RBV ACTD will develop and demonstrate rapid collection and generation of high-resolution (up to 1-m grid spacing) digital terrain elevation data using imagery from aircraft and satellite platforms to generate terrain feature data and map backgrounds. The ACTD will provide and leave behind computer workstations and applications software to (1) generate high-resolution terrain databases, (2) accept high-bandwidth data feeds for remotely processed information, (3) analyze courses of action using mission planning and embedded wargaming software, and (4) conduct mission rehearsals. This ACTD also will provide a tool for exploring warfighting concepts and doctrine.

Four elements will be integrated in this ACTD: source data collection, digital terrain database generation and tailoring, database dissemination, and applications software. Six parameters will be evaluated: rapid access to archived terrain data and imagery; rapid collection of high-resolution terrain elevation data and multispectral imagery using a tactically viable platform; rapid generation of digital terrain databases including semiautomated extraction of selected terrain features; tailoring of terrain databases to meet specific user needs; a hierarchical spatial database management system that will accommodate dynamic revisions and provide users quick access to data sets optimized for their needs; and mission planning, rehearsal, course-of-action analysis, and embedded wargaming software to enable the commander to determine mission approach, and monitor execution of that mission.

By FY98, the program will demonstrate a capability to merge multiresolution elevation and feature data with real-time tactical databases, and demonstrate on a prototype battlefield visualization system. It will generate tailored databases for visualization workstations. By FY99, the goal is to demonstrate an accelerated semiautomated terrain feature-extraction process and a capability to disseminate and integrate selected sets of intelligence, C^2, logistics, weather, situation awareness, and high-resolution terrain data. The FY00 goal is to demonstrate and leave behind an objective rapid battlefield visualization capability with XVIII Airborne Corps.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603734A	T12	9.4	10.2	13.8	11.8	0	0	0
0603750D	P523	0	1.5	2.0	3.0	0	0	0
	Total	9.4	11.7	15.8	14.8	0	0	0

A.07 ***Battlefield Awareness and Data Dissemination ACTD.*** This ACTD will install and evaluate an operational system letting commanders design their own information system; deliver to warfighters an accurate, timely, and consistent picture of the battlespace; provide intelligent search and retrieval capabilities, access to key transmission mechanisms, and worldwide data repositories; and create and enhance leave-behind capabilities providing continuing support to the operational user. Technologies will be DII COE compliant. Capabilities and services to be developed and evaluated during FY97 include an Information Dissemination Management Node located in Washington, DC; Warfighter's Associates terminals in use by the Army, Navy, and Marines at CONUS locations; leased Global Broadcast Services (GBS) commercial satellite communications interfaces; creation and dissemination of an operational picture of friendly and enemy force status; and dissemination of integrated imagery, video, signals intelligence, terrain, weather, Global Command and Control System, and Maneuver Control System data. Enhanced legacy systems focus on improving bandwidth utilization and expanding the user base to include additional major military commands. FY97 efforts culminate in delivery of an operational capability supporting CONUS-based users and enhancements to the current capability supporting OCONUS users. FY98 efforts focus on an increased level of automation previously provided to users, and extended information management and dissemination support from the level of individual battalions/ships (as demonstrated in FY97) to the joint/coalition level. This ACTD will also provide new information management capabilities including creation of a 3D graphical depiction of a consistent operational picture by near-real-time integration of all relevant databases with identification and semiautomated resolution of differences, and tests of a uniform software layer that demonstrates the ability to create a completely integrated tactical internetwork across the battlespace. FY99 and FY00 efforts focus on the incremental addition of operational capabilities. Examples include an advanced information anchor desk, advanced repository brokering, rapid repository mediator generator, advanced query formulation, and advanced resource utility visibility with associated controls. This ACTD significantly enhances the ability of the commander and commander's staff to rapidly achieve comprehensive battlespace awareness by integration of multiple simultaneous views prepared by individual national/service/sensor correlation systems and the redundant/non-time-synchronous data from numerous legacy databases; management of preserved/unresolved differences between input databases; and presentation of results to users allowing them to tailor their views while not overwhelming their ability to absorb the data. This challenge requires not only the capability to merge and manage these multiple views but also the ability to support potentially thousands of users that have differing data requirements (spatial, temporal, granular) with data that is timely, manageable, and appropriate. BADD provides the DII COE compliant information management tools necessary to efficiently identify and extract information to be broadcast and manages the broadcast resources to ensure that each user receives the data in a timely manner. A third challenge addressed by this ACTD is the need to create a uniform network software layer. The prototype network demonstrated by BADD will serve to remove the requirement to adapt each information source and application to use a custom GBS interface and will create a completely integrated tactical internetwork across the battlespace.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603760E	CCC-02	32.4	47.0	49.9	20.0	0	0	0
0603750D	P523	4.0	4.0	2.0	2.0	0	0	0
	Total	36.4	51.0	51.9	22.0	0	0	0

A.09 ***Semiautomated Imagery Processing ACTD.*** The goal of this DTO is to make imagery a responsive source for a commander in providing a dominant battlespace awareness by focusing on theater and tactical sensor exploitation, tactical surveillance, and site monitoring. The program will increase image analyst efficiency in exploiting large volumes of image data produced by current theater and future tactical imaging platforms. The system will aid the analyst in detecting and recognizing isolated targets, significantly reduce false alarms (PFA = 0.01/km^2), and recognize force structure (e.g., maneuver battalions).

During FY97, a laboratory working model of the baseline image analyst tools and workstation components will be demonstrated, then integrated into a van and field tested to prepare for an engineering evaluation exercise. At the completion of this period, the Semiautomated Imagery Processing (SAIP) Demonstration System (SDS) will participate in Operation Desert Capture at the National Training Center. Integration will add both synthetic aperature radar (SAR) and electro-optical (EO) site monitoring capability to support the enhanced configuration. In FY98, the site monitoring and enhanced capability will be field tested and available to support a user assessment. SDS will be capable of operating in a split mode with image formation at one site (with MOBSTR) and exploitation at another site. During user evaluation, military operators will provide assessments of the interface, tools, and reporting capability. The final transition configuration will be tested at a CONUS site in late FY99. During FY99, the system will be used by military operators as required. The baseline configuration will integrate template-based SAR automatic target recognition (ATR), cluster analysis, object-level change detection, and interactive target recognition technology to support U–2 ASARS–2 image exploitation. The enhanced configuration will add EO site monitoring and force structure analysis capability. The final transition configuration will add SAR site monitoring and make minor improvements in previous configurations to develop a more robust system. SAIP will be the first insertion of ATR technology into an operational exploitation system (e.g., the Air Force CARS/DGS and the Army ETRAC). Its goal of 0.9 probability of target detection will reduce exploitation of SAR imagery from 15 to 5 minutes per image. This will enable image analysts to exploit more data in shorter timelines.

Novel image processing and exploitation elements that SAIP will provide include (1) terrain analysis and area delimitation, (2) target detection and classification, (3) elimination of objects not of interest, (4) detection of changes between sequential images, (5) recognition and identification of specific objects/targets, (6) detection and assessment of groups of objects/ targets, (7) recognition of detailed changes at fixed sites or small scenes, (8) advanced methods for image analysts' interaction, (9) automated registration, and (10) traditional analyst tools, including image registration, recall of previous results, image manipulation, mensuration, and assisted report writing

The SAIP demonstration capability will evolve from supporting current U–2 ASARS–2 sensor resolutions with improved tactical surveillance of ground and missile order of battles to enhanced capability to support the higher resolution capability of the U–2 ASARS–2 Improvement Program and the EO sensors, Global Hawk, and Dark Star programs.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603762E	SGT-04	30.4	26.0	23.3	0	0	0	0
0603750D	P523	4.0	2.0	2.0	0	0	0	0
	Total S&T	34.4	28.0	25.3	0	0	0	0
0305154D*	P527	3.0	6.0	6.0	0	0	0	0
	Total	37.4	34.0	31.3	0	0	0	0

*Non-S&T funds.

A.10 ***High-Altitude Endurance Unmanned Aerial Vehicle ACTD***. This DTO will develop and demonstrate a joint, adverse-weather, long-endurance, wide-area, day/night reconnaissance and surveillance capability in both a low-observable and conventional configuration. Operationally, the High-Altitude Endurance Unmanned Aerial Vehicle (HAE UAV) system will provide continuous, broad-area surveillance over the battlefield with real-time connectivity to existing service exploitation centers. The only requirement for each system is that the flyaway price of each air vehicle be less than $10 million; all other characteristics (range, altitude, payload, etc.) are tradable against the unit flyaway goal. The program will resume Dark Star flight tests and initiate Global Hawk flight tests in FY97. Phase II developmental flight tests will conclude in FY98. At the conclusion of this phase, management of the HAE UAV program will undergo transition to the Air Force. Phase III user demonstrations of both Dark Star and Global Hawk will be conducted in FY98–FY00. The UAVs will carry a variety of electro-optical, infrared, and SAR sensors as well as wideband satellite communications. At the end of the ACTD (early FY00), the program will undergo transition out of an ACTD and into production. With respect to power sources, this DTO is related to DTAP DTOs SE.26 and SE.27.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0305154D*	P527	178.0	160.0	165.0	25.0	10.0	0	0
	Total	178.0	160.0	165.0	25.0	10.0	0	0

*Non-S&T funds.

A.11 ***Counter-Camouflage Concealment and Deception ATD.*** This ATD will provide the warfighter the ability to detect and classify targets obscured by foliage and tactical deception techniques. The current theater surveillance and reconnaissance suite lacks the capability to reliably detect counter-camouflage concealment and deception (CC&D) targets or to penetrate any level of foliage. A significant outcome will be a CONOPS for the use of this class of sensors on the Predator and Global Hawk unmanned air vehicles (UAVs), and integration of the image exploitation capability on the battlefield into the Semi-Automated IMINT Processing common integrated ground/surface system (CIGSS) architecture, being developed under a separate ACTD. The capability afforded by this ATD is essential to achieving total battlefield awareness as there is no current capability to detect and cue targets under any significant foliage concealment.

From a sensor aspect, it focuses on foliage-penetrating (FOPEN) radar (VHF or UHF) on the high-altitude Global Hawk UAV, and the use of hyper spectral imaging (HSI) on medium-altitude Predator platforms, to detect and identify obscured and camouflaged targets. The quantitative FOPEN ATD objective is to demonstrate less than one false alarm in 10 sq km at 25 km range for targets in foliage or under tactical camouflage. The preferred FOPEN radar frequency and the wavelength and number of bands required for HSI will be developed during FY97 tests. The radar capability will be integrated into the Global Hawk UAV, to provide coverage out to 50 km standoff range, upon completion of DARPA FOPEN ATD tests on a manned platform.

Key demonstrations include, in FY97, tests with existing VHF and UHF FOPEN radars and HSI sensors, to validate system requirements and initiate customer support of CONOPS; in FY98, the counter-CCD ATD, to demonstrate real-time target detection and cueing in SAIP architecture; in FY99, a user-defined CONUS test, to validate FOPEN and HSI image exploitation in CIGSS architecture using manned platforms, and 85% form-fit-function of the UAV sensors; and in FY00–01, user-defined EUCOM operational tests with sensors on UAVs and real-time images in CIGSS image exploitation units.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603762E	SGT-04	13.9	24.0	25.0	20.0	10.0	0	0
0603750D	P523	0	0	4.0	0	0	0	0
	Total	13.9	24.0	29.0	20.0	10.0	0	0

A.12 ***Information Security.*** The goal of this DTO is to develop, integrate, and demonstrate C^2 protect operational capabilities for tactical information and navigation systems (Tactical Internet and components). The DTO will demonstrate this capability through the use of existing guards, gateways, and multilevel workstations to provide automated interfaces among U.S. and coalition forces. The demonstration also will attempt to provide all encryption gateways for extending ATM networking across service and coalition networks, building on FastLane and other emerging products. It will also demonstrate the capability to use simulation and modeling tools to project operational plans into network loading and analysis systems to begin the development of anticipatory network management capabilities. This will enable the warfighter to maintain the ability to accomplish dynamic, continuous synchronization of force operations and integrated force management. This DTO is inextricably linked to the IW programs and Science and Technology Objective developments, the results of which will be used to verify the level of protection that has been achieved by the developed/integrated HW/SW tools.

By FY98 the program will conduct a thorough assessment of the Tactical Internet and will document existing vulnerabilities through testing in the Digital Integrated/Technical Integration Laboratory. It will integrate available C^2 protect products into the Tactical Internet and evaluate the performance of C^2 protect products in a narrow bandwidth environment. A goal is to quantify the impact of C^2 protect products on (1) dynamic routing and network protocols and (2) Tactical Internet applications (Appliqué and ABCS). By FY99, the program will evaluate network security intrusion selection (Net Stalker), Firewalls (Sidewinder, Gauntlet, Cyberguard, Fire-one), and security guards (Radiant Mercury, C^2 Guards, Ops Intel). In the areas of Internet controllers (INCs) and tactical multinet gateways (TMGs) (commercial routers), the program will identify or develop net management tools (TKI Net), access control lists (internet protocol (IP) filtering), identification and authentication of network management tools, and virtual private network (IP encryption).

The FY00 goal is to continue the development of hardware/software fixes for the Tactical Internet, through iterative testing and fixing. The DTO will demonstrate the capability of the developed tools to protect the networks. The program will identify tactics, techniques, and procedures (TTPs) and engineering strategies for developing a unified IW protect system. This DTO serves as the enabling technologies for IS.17.01 and supports JWSTP DTO A.04.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603006A	D247	0	0	0	3.0	3.0	0	0
	Total	0	0	0	3.0	3.0	0	0

A.13 ***Satellite C^3I/Navigation Signals Propagation Technology.*** The efficient and unrestricted flow of information among all levels of command is critical to the success of every military operation. Certain regions of the world experience unusually high occurrences of communication outage that can seriously affect military operations; one such region occurs in equatorial latitudes, as was demonstrated during Desert Storm. The purpose of this DTO is to develop and demonstrate technologies to enhance warfighter capabilities to assess and respond to dynamic ionospheric conditions that limit command, control, communications, and intelligence (C^3I) functions and Global Positioning System (GPS) navigation. The technology challenge is to quantify and provide real-time monitoring and forecasting of ionospheric limitations to radiowave propagation on military C^3I and navigation systems. Special emphasis in the DTO is on equatorial ionospheric phenomena that affect military communication systems operating in and near this geographic area. The availability of ground-based ionospheric sensing data will lead to improved specification of the battlespace in the near term. The midterm goal is to fly a specially instrumented satellite as an in situ monitor to improve the ionospheric forecasting. The vision of this DTO is to provide real-time specifications and forecasts of the battlespace effects on C^3I and GPS navigation by combining ground and satellite observations with predictive automated models. With respect to power sources, this DTO is related to DTAP DTOs SE.26 and SE.27.

Milestones include, in FY97, collecting and assessing signal propagation anomaly data at equatorial latitudes, resulting in a 60% improvement in signal outage specification for military communications in equatorial regions; in FY98, assessing environmental impacts to MILSATCOM for Middle Eastern locations, resulting in a 75% improvement in localized connectivity specification of Mid-East communication via MILSATCOM; in FY01, developing and flying an equatorial satellite to monitor/predict signal outages, resulting in the first-ever opportunity to collect global equatorial ionospheric disruption data for development of models to specify and predict effects on military communications; and in FY03, fusing ground- and space-based data sources, resulting in a 90% improvement in global specification/75% predictions.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	1010	2.4	2.2	2.2	2.2	2.3	2.6	2.7
	Total	2.4	2.2	2.2	2.2	2.3	2.6	2.7

A.14 ***Tactical Unmanned Aerial Vehicle ACTD.*** The Tactical Unmanned Aerial Vehicle (TUAV) will provide the Army Brigade, USMC Marine Air Ground Task Force, and Navy commanders with a dedicated unmanned aerial vehicle system that delivers timely, accurate, and complete targeting and other battlefield information to their units in near-real time (i.e., military utility). The TUAV system must come as close as possible to meeting the following basic performance requirements:

Parameter	Basic	Option
Range	200 km	
Target Location Error	Best possible using state-of-the-art GPS (not to exceed 100 m)	
On-Station Endurance	3 hr	4 hr
Launch and Recovery	Unprepared surface/large-deck amphibious ships	Add automatic takeoff and landing
System Mobility	2 HMMWVs/1 trailer	
System Deployability	Single C-130 (4 A/Vs and ground equipment)	
Payload	EO/IR	SAR
Integration	EMI shielding/corrosion inhibition	
Datalink	Compliant with JII (200-km LOS at sea level)	Common datalink
Propulsion System	As provided by contractor	Heavy fuel engine

The TUAV system consists of ground control equipment, one remote video terminal to provide payload information in the area of operation, four modular mission payloads, communications devices, four air vehicles (a means of launch and recovery), and one mobile maintenance facility for every three TUAV systems. (For ILS planning purposes, a TUAV system for the Navy produced during full-rate production would consist of eight air vehicles and modular mission payloads, as well as maintenance facilities configured to the specific ship, and would be ready by FY98.)

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
TBD*		51.5	48.5	0	0	0	0	0
	Total	51.5	48.5	0	0	0	0	0

* Non-S&T funds.

A.16 ***Navigation Warfare ACTD.*** This ACTD has three goals: to develop techniques and equipment to protect the use of the Global Positioning System (GPS) in the face of hostile countermeasures, to limit the ability of hostile forces to obtain military benefit from GPS, and to provide an environment to develop and refine concepts of operation (CONOPs) for the use of GPS in the face of electronic countermeasures. A fourth objective is to accomplish the first three goals without impacting the commercial use of GPS outside of the theater of military operation. No changes to the GPS satellites or to the GPS navigation signal structure are planned as part of the ACTD. The ACTD will start in FY96. Initial test demonstrations could occur in late 1996. A series of demonstrations will occur between FY96 and FY99.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603750D	P523	4.5	3.9	0.3	0	0	0	0
	Total	4.5	3.9	0.3	0	0	0	0

A.17 ***Joint Task Force ATD.*** The goal of this DTO is to provide a deploying CJTF a rapid crisis response capability for a range of situations, from major regional conflicts (MRCs) to operations other than war. The program develops advanced information processing concepts to support a geographically dispersed staff for crisis management. Concepts include an architecture and infrastructure, software tools, applications, and repository that can be integrated to form the foundation of a next-generation JTF C^4I capability for planning, execution, and the management of joint force operations in the areas of logistics, transportation, weather, and communications. This technology base facilitates a scaleable joint planning, replanning, and execution system providing enhanced collaboration, visibility, and common perception of the battlespace. Specific technology advancement will be achieved in applications and tools that, when combined, form a series of anchor desks (weather, transportation, and communications) and toolkits (JTF planner and ACPT) providing common information services. They include a series of information servers: a communications server to provide adaptive and dynamic bandwidth facilitating collaboration, sharing, and information retrieval; a map server for mapping tools; a data server for query-based views of distributed, heterogeneous databases; a web server to exploit web technologies; a situation server for complex situation interpretation; a plan server for course of action (COA) development; and a model server for simulation modeling. The ATD will develop an object repository and schema to provide access to consistent C^4I and planning processes, to which new objects can be easily added. The combination of the above applications, servers, schema, and architecture is termed the Joint Planning System (JPS). Technologies supporting this development include Common Object Request Broker Architecture (CORBA), object-webs, adaptive objects, C^2 schema, bandwidth adaptive networking, distributed collaboration, mobile code, and modeling and simulation.

FY97 will see completion of the first phase of deployable JTF C^3 development (mobile C^3, plan rehearsal and refinement during deployment, intelligent interfaces). The program will define and evolve C^4ISR architecture extensions and extended reference architecture applications. FY98 goals are to commence advanced anchor desk, services, and other expanded capabilities development; demonstrate initial execution and dynamic replanning functionality; develop planning and vulnerability associates, plan and situation monitoring tools, situation projection and visualization tools, persistent report and briefing tools; and adaptive workflow tools; and continue technology program insertion and integration into other DoD and government and civilian agencies over the life of the program. In FY99, the program will demonstrate initial advanced execution and dynamic replanning functionality. FY99–FY02 will continue advanced development and conduct integrated feasibility and other progress demonstrations. The FY02 goal is to complete the second phase of development.

The JTF ATD will afford significant operational payoff, with goals of 100 times faster dynamic planning and 10 times more options than present systems, 15 minutes to learn to use, and rehearsal and refinement enroute.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603761E	CST-02	13.2	12.5	22.0	12.0	10.0	0	0
	Total	13.2	12.5	22.0	12.0	10.0	0	0

A.18 ***Advanced Cooperative Collection Management.*** The goals of this DTO are to enable effective and efficient utilization of current and forthcoming collection assets, including unmanned aerial vehicles (UAVs), and to provide warfighters virtual ownership of intelligence, surveillance, and reconnaissance (ISR) systems to ensure timely, focused sensing of the battlespace in support of the operational plan. The program will provide enabling technologies to conduct continuous asset planning, automatic retasking, multi-asset synchronization, and automated collaborative collection.

The FY98 goal is to develop and integrate emerging technologies with U–2 and high-altitude endurance UAV concepts of operations and demonstrate continuous asset planning and automatic tasking with the U–2, Joint STARS, Dark Star, and Global Hawk. Continuous asset planning will match the right asset with the right task at the right time (15-minute clock cycle versus current 12-hour cycle) and achieve an 85% efficient plan with 60 preplanned image operations/hour, and asset optimization per mission as a function of strategy-to-task. Automatic tasking will match dynamic trigger events to sensors and available platforms, determine collection feasibility, and send execution commands to the sensor asset. For a single asset, the goal is 20 retasks/hour while retaining 85% of preplanned tasks for cross-cueing assets, and 10 cross-cues/hour while retaining satisfaction of 85% of previous tasking. By FY99, the program will demonstrate full advanced cooperative collection management (ACCM) capabilities, including multi-asset synchronization and automated collaboration, with U–2, Dark Star, and Global Hawk. Multi-asset synchronization will use automatic, optimizing resource allocation algorithms so that all available platforms are treated as a single sensor constellation to be optimized for availability, feasibility, suitability, and cost/benefit. The multi-asset synchronization measure of performance is schedule repair expressed as change to sensor utilization rates as a function of changed guidance, new targets, percent loss of previous targets, and time to be determined. Collaborative collection management will be implemented at multiple nodes so that status of assets, requests and corresponding tasking, and exploited disseminated products are available to all participants. Performance measures are collection utility, geolocation accuracy, quality, and completeness. By FY00, the program will demonstrate and evaluate ACCM capabilities with high-altitude endurance (HAE) UAVs, national capabilities, U–2, and Guardrail Common Sensor. By FY01, the goal is to complete the transition of continuous asset planning, automatic tasking, and multi-asset synchronization to the HAE Mission Control Element and users of the Joint Collection Management Tools. Final software enhancements will be completed by FY02.

Key technology obstacles are techniques for prediction of expected collection performance to feedback to information requester, information retrieval, hierarchical and distributed collaborative decision making, and algorithms for asset scheduling, dynamic visualization, and distributed database maintenance.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603760E	CCC-01	0	10.6	14.2	25.0	35.0	0	0
	Total	0	10.6	14.2	25.0	35.0	0	0

A.19 ***Extending the Littoral Battlespace (Sea Dragon) ACTD.*** This Sea Dragon ACTD will demonstrate an Extended Littoral Battlespace Combat Operations System built on existing Global C^2/Joint Maritime Command Information System/Marine Air-Ground Task Force C^4ISR infrastructure, enhanced by collaborative workspaces, intelligent software agents, and a intelligently networked/webbed battlespace. This system will enable commanders to dynamically control dispersed units, logistics, and fire to achieve a more adaptive, flexible, and survivable Naval Expeditionary Force. The ACTD initially will exploit and integrate COTS/GOTS technologies. The following demonstrations are planned: in FY97, multiuser-domain, object-oriented groupware architecture facilitating 50 collaborating workstations; an airborne mobile router and routing protocols with a 0.9 probability of successful user discovery and a mean time to successful mobile user registration of 0.5 min; intelligent network management agent-based service allocation demonstrating 0.95 accurate admissions, 0.95 allotment of requested services, and a 0.9 compliance rate for traffic police and reliability; in FY98, a containerized missile system, an initial prototype 50-participant enhanced combat operations center (ECOC) featuring a virtual reality battlespace visualization workbench, integration of INITS commercial satellites with SOUNDER aerostat communications node providing a littoral battlespace C^4ISR web footprint of 150-mi radius, a reconnaissance/surveillance/target acquisition (RSTA) vehicle-integrated router capable of 9.6 KB/s, SENDER unmanned aerial vehicle (UAV) and urban unmanned minihelicopter loaded with 2-lb sensor packages and alternatively delivering 2-lb payloads of deployable jammers, and 0.98 accurate "in-the-box" asset visibility for containerized cargo. Then the emphasis will be on upgrading demonstrated capabilities, with the following demonstrations: in FY99, Beta test groupware for multiple collaborating enhanced ECOCs with an agent-assisted planner and RSTA mobile router capable of 64 KB/s, man-portable radar jammer, and one-man VIPER sniper detection/location system; in FY00, software wrappers capable of integrating 10-type legacy platforms supporting 50 agents and 35 applications, an RSTA mobile router capable of 128 kB/s, and automatic target recognition (ATR) unattended ground sensors that are accurate in 98 percent of their reports; and in FY01, robust acquirable technologies including distributed remote weapons control and seamless integration of the enhanced ECOC with UAV and ATR sensors in the littoral battlespace web. Demonstrated technologies will then undergo transition to acquisition.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603640M	C2223	4.0	6.1	7.8	9.0	8.6	0	0
0603750D	P523	0	2.0	5.0	5.0	5.0	0	0
	Total	4.0	8.1	12.8	14.0	13.6	0	0

PRECISION FORCE

PRECISION FORCE

B.01 ***Precision Rapid Counter Multiple Rocket Launcher ACTD.*** This DTO will develop and demonstrate a joint adverse-weather, day/night, end-to-end, sensor-to-shooter, precision deep-strike capability to locate, identify and kill high-value, short-dwell, time-sensitive targets and assess damage within tactically meaningful timelines. This effort will demonstrate a significantly enhanced capability for U.S. Forces Korea to neutralize the newly deployed North Korean 240-mm multiple rocket launcher system (MRLS). Because of the brief time in which these targets are expected to be exposed and vulnerable to counterfire, near-continuous surveillance and near-instantaneous target acquisition are required.

The FY96 ACTD OCONUS demonstration focuses on the leave-behinds for targeting, command and control, automation, communication, weapon delivery, and joint Air Force and Navy fire support. Beginning in FY97, the leave-behind capabilities—along with new tactics, techniques, and procedures developed by the user—will enhance the CINC's capability to defeat the 240-mm MRLS threats. These capabilities include TOC automation and connectivity; automated weapon–target pairing; improved unmanned aerial vehicle sensors, in particular Reconnaissance Infrared Surveillance Target Acquisition and Second Generation Technology II (RISTA II) and synthetic aperture radar (SAR) sensors with aided target recognition); Improved Firefinder; terrain visualization capability; and automated request for fire connectivity with Air Force close air support (CAS) and naval fire support. This capability will provide the CINC an improved warfighting capability to neutralize/destroy high-priority threats.

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0603238A	AD177	14.4	5.3	0	0	0	0	0
	Total	14.4	5.3	0	0	0	0	0

B.02 ***Rapid Force Projection Initiative ACTD.*** This DTO demonstrates a highly lethal, survivable, and rapidly deployable enhancement to an airlift-constrained early entry task force. The Rapid Force Projection Initiative (RFPI) is based on a system of systems (SOS) of advanced sensors (hunters) and weapons (standoff killers) connected by a robust command, control, and communications (C^3) system. Ground and aerial hunters are equipped with advanced sensor packages capable of detecting targets well forward of friendly forces. Standoff killers are advanced, long-range precision weapon systems designed to engage and kill enemy armor and artillery forces beyond their ability to counter. An integrated C^3 system, compliant with Army technical architecture and digitization initiatives, relays near-real-time situational awareness and targeting information from the hunters through battlefield computer networks to the standoff killers.

The RFPI ACTD concept emphasizes the integration of all RFPI technologies into an overall SOS architecture, integration of the RFPI SOS with the legacy organic systems of the ACTD experiment force, digital augmentation of the FORSCOM experiment brigade tactical operations center, baselining of the new hunter-standoff killer operational concept, and live/virtual integration. The RFPI ACTD management plan measures of success are (1) increased situational awareness of the size and location of the threat array, applying integrated sensor orientation and sensor interconnectivity across the battlefield by 50% improvement over the base case (minimum) and 100% improvement over the base case (goal); (2) destruction of the initial threat target array beyond 3 km by a 75% improvement over the base case (minimum) and a 95% improvement over the base case (goal); and (3) an increase in the survivability of the brigade by a 20% improvement over the base case (minimum) and a 45% improvement over the base case (goal).

ACTD milestones include residuals delivered for integration of RFPI SOS (FY97), Battle Lab Warfighting Experiment 2 (Lt. Digital TOC) (FY97), Battle Lab Warfighting Experiment 3 (Virtual Rehearsal) (FY97), FORSCOM Experiment Unit Home Station Training (FY98), ACTD Field Experiment (FY98), and extended user evaluation of residuals (FY99–FY01).

Technical barriers include the availability of advanced digital communications hardware and software, integration of participating elements into the RFPI SOS, integration of RFPI SOS with organic material of the FORSCOM experiment unit, and live/virtual integration.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603313A	D486	7.8	8.4	5.1	0	0	0	0
0603313A	D493	24.2	29.8	27.9	13.6	11.4	0	0
0603313A	D380	0	4.5	5.9	1.0	0	0	0
	Total	32.0	42.7	38.9	14.6	11.4	0	0

B.03 ***Precision Signals Intelligence Targeting Systems ACTD.*** The Precision SIGINT Targeting Systems (PSTS) ACTD is a joint service and defense agency effort to develop and demonstrate a near-real-time, precision targeting, sensor-to-shooter capability using existing national and tactical intelligence resources. The combination of tactical airborne and national SIGINT assets adds a new dimension to the role of intelligence in information warfare. The goal of the PSTS ACTD is accurate determination of potential enemy threat emitter positions and the rapid relay of those positions to forces that can engage and eliminate the threat. The PSTS concept of operations is being worked closely with USCINCPAC and USFK to ensure that the warfighter's needs are being met. This coordination will ensure multiservice compatibility during the development process. Army, Navy, and Air Force aircraft and sea-based units have participated in past demonstrations and will be included in future demonstrations.

The PSTS ACTD seeks to achieve an order-of-magnitude improvement in geolocation accuracy over any existing single-system SIGINT capability. The program goal is to determine threat position in a time frame such that munitions may be rapidly delivered by friendly forces. This threat-positional data will be delivered via the Tactical Data Dissemination System (TDDS) and intradivisional Army communications systems.

An early PSTS demonstration focused on the technical feasibility of combining tactical and national SIGINT assets to achieve geolocations of pulsed (i.e., ELINT) emitters. The program is evolving to develop geolocations on nonpulsed (i.e., COMINT) emitters as well. The FY98 demonstration is envisioned to be the final demonstration and will leave behind a limited operational capability with military forces.

Technological hurdles include precision timing, navigational accuracy, and errors associated with geodesy and ephemeris.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603794N	R2239	12.3	7.5	0	0	0	0	0
0603762E	SGT-01	1.0	8.5	8.5	0	0	0	0
	Total	13.3	16.0	8.5	0	0	0	0

B.05 ***Target Acquisition ATD.*** The goal is to provide the warfighter a system for night or poor visibility usage that will give him knowledge of the battlespace in real time. By FY98, the program will develop and demonstrate an extended-range, multisensor target acquisition suite for future tank, cavalry and scout vehicles. The multisensor suite will consist of a second-generation thermal imaging sight with an automated wide-field-of-view search capability coupled to aided target recognition/identification algorithms, a multifunction laser, and a low-cost moving target indicator (MTI) radar (growth to stationary target indicator (STI)). These enhanced target acquisition capabilities offer the user a more resilient, consistently performing sensor suite capable of better performance under adverse conditions in a fraction of the current timeline found in fielded systems. Fewer false alarms and increased sensor sensitivity lead to fewer missed targets and improved fire control hit probabilities, thus improving combat vehicle lethality and survivability. These capabilities also will lead to a decrease in fratricide. Target identification ranges will be extended by 67% for exposed targets and 50% for partially obscured targets. Automation will reduce search timelines by 60–80% over manual search and thus streamline crew workloads for future combat vehicles. The Target Acquisition ATD will permit effective employment of weapon systems under all ambient light and atmospheric conditions, providing a means for the warfighter to gain full knowledge of the battlespace in real time.

Technical barriers include optimizing forward-looking infrared (FLIR)/multifunction aided target recognition fusion algorithms, and developing a multifunction laser that fits the space constraints of the current M1 laser.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603710A	DK87	8.3	1.9	0	0	0	0	0
	Total	8.3	1.9	0	0	0	0	0

B.06 ***Air/Land Enhanced Reconnaissance and Targeting ATD.*** The goal of the ALERT ATD is to provide the helicopter pilot/gunner the ability to automatically acquire and identify stationary and moving targets from a high-speed, dynamic aerial platform such as a scout/attack helicopter. The net result will be a more efficient warfighting platform with greater survivability.

The fast pace of many engagement scenarios requires a significantly improved capability to find and service targets while improving survivability. ALERT will exploit emerging developments in on-the-move aided target recognition (ATR) algorithms, including long-range detection, target identification, scene-to-scan correlation, smart sensor management, and temporal FLIR processing for MTI. ALERT also will evaluate the additional benefit provided by enhanced laser rangefinder functionality.

By FY98, the program will demonstrate baseline on-the-move performance using second-generation FLIR and standard rangefinding mode. The FY99 goal is to integrate laser rangemapping capability and enhanced on-the-move search/detection algorithms. By FY00, the program will integrate a laser profiling capability to demonstrate target identification and transition to the survivable armed reconnaissance on the Digital Battlefield ACTD. The final demonstration in FY00 will demonstrate the ability to provide long-range detection (in excess of 4,000 m) from a platform moving at speeds up to 180 kn. The program will demonstrate that automation can extend the safe ingress and egress rate of the platform by 50–75% for full threat coverage over manual acquisition. It also will demonstrate search correlation false alarm suppression modes to further reduce the false alarm rate to meet RAH–66 Comanche requirements.

Technical barriers include developing algorithms for motion compensation, optimizing FLIR/multifunction ATR fusion algorithms, and data imagery compression.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603710A	DK86	1.3	6.0	5.8	2.3	0	0	0
	Total	1.3	6.0	5.8	2.3	0	0	0

B.07 ***Joint Continuous Strike Environment (Proposed ACTD).*** The objective of JCSE is to focus technology and concepts to enable the application of a joint weapon suite to neutralize time-critical, high-value targets. The product is an integrated system for joint, near-real-time attack operations based on distributed, cooperative engagement planning and execution. JCSE will demonstrate four capabilities: semiautomated target prioritization, continuous weapon availability monitoring, optimized weapon target pairing, and near-real-time airspace deconfliction.

JCSE capabilities will be demonstrated in exercise JWID97, as part of Roving Sands in May 1999; and in Atlantic Resolve in August 1999. A final demonstration tying together the total Precision Force capability will be held in late FY00.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
Services, OSD*		1.0	6.0	8.0	2.0	1.0	0	0
	Total	1.0	6.0	8.0	2.0	1.0	0	0

*Non-S&T funds.

B.08 ***Arsenal Ship.*** The goal is to develop an Arsenal Ship (AS) functional design by the end of FY97. This timeline from concept design (FY96) through fabrication (FY00) represents half the development time of previous naval vessels of this complexity, contains four times the VLS cells found on a CG–52 class ship, has a fixed unit sailaway price of $450 million, and has a life-cycle cost 50% less than that of a naval combatant. This reduction is to be achieved through (1) innovative design, maintenance, operational methods, and procedures; and (2) greatly reduced manning—the crew will not exceed 50 people, which is 80% less than current naval vessels. The FY98 goal is to develop a detailed ship design encompassing all of the above attributes. The FY01 goal is to construct and test an AS capable of performing missions within the prescribed cost constraints.

Specific objectives that must be demonstrated include the ability to perform the operational mission for 90 days; architecture, communications, and datalink functions capable of satisfying the AS concept of operations; and the capability for remote launch of strike, area air warfare, and fire support weapons. The planned test program will include a salvo launch of up to three Tomahawk missiles in 3 minutes; a single SM2 launch using the AS as a remote magazine for a cooperative engagement capability ship, a single Tomahawk launch using the AS as a remote magazine for air-directed and shore-based targeting, and a single weapon launch from a VLS cell in support of a naval surface fire control mission digital call for fire.

The program will demonstrate the proper balance between passive survivability and active self-defense sufficient for expected operational scenarios.

Program areas of risk include achieving the shortened design time goals and meeting the system sailaway cost goals.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603763E	MRN-01	15.0	47.0	50.0	36.0	22.0	0	0
	Total S&T	15.0	47.0	50.0	36.0	22.0	0	0
0603852N*	S2294	25.0	141.0	90.5	80.2	11.4	0	0
	Total	40.0	188.0	140.5	116.2	33.4	0	0

*Non-S&T funds.

B.09 ***Hunter Sensor Suite ATD.*** The HSS ATD will demonstrate a lightweight, low-observable, advanced long-range sensor suite with automatic target recognition (ATR) that provides rapid, multiple target acquisition and precision targeting handoff, integrated on stealthy hunter vehicles operating both stationary and on the move.

Specific capabilities to be demonstrated include a 70% increase in long-range target acquisition recognition ranges compared to the current AN/TAS–6 with two times lens scout sensor capability; a reduction in detection time of 80% through the use of ATR with a low false alarm rate; providing precision target location to within less than 50-m CEP; and providing sensor images over SINCGARS in less than 15 seconds.

Milestones for the HSS include a sensor and positioning demonstration in 8/97, delivery of HSS 1 to RFPI integration in 4/97, an ATR/HDIP/image compression demonstration in 6/97, an HSS/ATR demonstration in 8/97, and delivery of HSS 1 and HSS 2 (ACTD leave-behind systems) for user training in 12/96.

There are no identified technical barriers.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603710A	DK70	11.4	0	0	0	0	0	0
Total		11.4	0	0	0	0	0	0

B.10 ***Precision-Guided Mortar Munitions ATD.*** The PGMM ATD will demonstrate through simulation and testing the ability to engage, detect, and defeat armored vehicles and high-valued point targets such as earth-and-timber bunkers (ETBs), command posts, and logistic sites. The PGMM program will accomplish three tasks: in FY97, conducting common (120/105-mm) seeker captive flight tests (CFTs); in FY98, demonstrating an integrated man-portable fire control system; and in FY99, conducting all-up-round demonstrations for the 120-mm PGMM. The 120-mm PGMM must achieve a range of 12 km using a mass simulant that weighs no more than 40 lb. The 120-mm PGMM must defeat high-value targets including ETBs and light armored vehicles. The fire control exit criteria include a combined weight of the azimuth reference unit and computer of no more than 30 lb, an accuracy of 2 mil, and a ballistic solution within 2.5 min. This ATD supports the Rapid Force Projection Initiative ACTD.

Specific demonstrated capabilities for the PGMM include (1) as a measure of effectiveness (MOE), the ability to defeat armed vehicles and ETBs; and as a measure of success (MOS), a seeker CFT (FY97) that will provide required probability of detection and false target density data for RFPI simulation experiments. All-up PGMM firings (telemetry rounds, FY98–99) against armored vehicles and an ETB will demonstrate the full functional sequence of the PGMM to detect, guide to, and hit targets downrange. To ensure the effective range of 12 km, the MOS is a projectile firing of a tactical PGMM control glide round (telemetry, no seeker front end) that will demonstrate the full functional sequence of the round (fin/wing deployment, control glide, search maneuver) out to 12–15-km range (FY98). Lightweight fire control (less than 30 lb, 2-mil accuracy, 2.5 min ballistic solution for first round firing) supports all-up PGMM firings where a less than 30-lb mortar fire control will compute a firing solution. This will be demonstrated in FY98.

There are no identifiable technical barriers.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603004A	D43A	5.2	2.7	4.4	0	0	0	0
Total		5.2	2.7	4.4	0	0	0	0

B.11 ***Guided MLRS ATD.*** The Guided MLRS ATD is a guidance and control (G&C) package integrated with the current MLRS Extended Range Rocket. The Phase I G&C package consists of an inertial measurement unit (IMU), a flight computer, and canards driven by electromechanical actuators housed in the nose section of the rocket. Phase II integrates Global Positioning System (GPS) technology into the G&C package. The guidance package is designed to be compatible with various rocket payloads such as bomblets, precision guided submunitions, mines, and earth penetrator/unitary warheads.

Improvements in rocket delivery accuracies will reduce (1) the following number of rockets required to defeat the target by as much as sixfold at extended ranges, (2) the required number of launchers per fire mission, (3) the logistical burden, (4) the duration of the fire mission, and (5) the minimum safe distances to avoid fratricide and collateral damage. IMU design will provide the system with a 2–3-mil delivery accuracy at all ranges. The GPS-aided G&C package provides the system with a 10-m CEP delivery accuracy at all ranges. System benefits are evaluated through ongoing Rapid Force Projections Initiative (RFPI) force-on-force modeling, analysis, and simulation during the RFPI ACTD field experiment in FY98. Milestones for the Guided MLRS include five flights tests (FY98) in support of the RFPI ACTD. System benefits are being evaluated through ongoing RFPI force-on-force modeling and analysis.

There are no technical barriers identified.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603713A	D380	5.5	4.5	0	0	0	0	0
	Total	5.5	4.5	0	0	0	0	0

B.12 ***Enhanced Fiber Optic Guided Missile ATD.*** The EFOGM ATD will develop and confirm a precision standoff capability against high-priority ground and airborne (helicopter) targets under day, night, and adverse weather (DNAW) conditions out to a range of 15 km. The ATD will demonstrate, during the Rapid Force Projection Initiative (RFPI) ACTD, a remotely directed missile system that can operate from defilade to engage targets also in defilade. The seeker incorporated into the missile provides for friendly force recognition, which, coupled with the gunner in the loop, contributes to fratricide avoidance and, under most conditions, positive hostile identification. The EFOGM capability will be a killer element of the composite hunter/standoff killer concept identified in the RFPI. The RFPI addresses the challenge of providing light, highly lethal and survivable technologies to an early-entry force, within airlift constraints. The EFOGM also will participate in the RFPI large-scale field experiment (FY98).

Exit criteria for the EFOGM include availability of short-range (1–15 km) firepower against ground and air targets for early-entry forces; engagement of non-line-of-sight targets by forces deployed in defilade; provision of a means of assisting in battlefield management by automating the presentation of situation awareness information to the EFOGM gunner as well as automating the receipt/transmission, processing, and display of C^2 information; tactical deployability (C–130 A/C); missile seeker imagery exploitation; conduct of precision strike; and domination of the maneuver battle.

The current EFOGM ATD schedule is a two-phase development effort. EFOGM will deliver one mobile and two stationary simulators; a fire unit load of simulated missiles; and 12 FUs, three platoon leader vehicles, and 300 missiles to support a series of three demonstrations to be conducted during the performance of the ATD. The program incorporates the integrated product team (IPT) concept in the acquisition structure to significantly lower the unit cost of the missiles while providing sufficient hardware to conduct the demonstrations. These demonstrations include an RFPI field demonstration in FY98 and a 2-year extended user evaluation beginning in FY99. These remaining activities will be conducted by a unit of FORSCOM.

The DNAW seeker is considered the single most costly component of the missile assembly. It is intended that leveraging on focal plane array efforts currently underway by the Defense Advanced Research Projects Agency will be maximized. Consideration will be given to manufacturability as well as effective array size and seeker sensitivity.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603313A	D496	37.7	57.9	36.7	15.1	3.9	0	0
	Total	37.7	57.9	36.7	15.1	3.9	0	0

B.13 ***High-Mobility Artillery Rocket System.*** This DTO will develop and demonstrate a lightweight, C–130-transportable version of the M–270 Multiple Launch Rocket System (MLRS). Mounted on a 5-ton family of medium tactical vehicles (FMTV) truck chassis, it will fire any rocket or missile in the M–270 family of munitions. HIMARS will use the same command, control, and communications as well as the same crew as the MLRS launcher, but it will carry only one rocket or missile pod.

By the second quarter of FY98, HIMARS will demonstrate a man-rated cab to protect its crew from rocket exhaust gases and launch debris. It will be fully C–130 transportable, both in weight and in cubage, and will fire rockets and missiles in the M–270 family of munitions. Its automated onboard reload capability and quicker aiming platform movement will provide accelerated mission timelines, enabling greater survivability for the warfighter.

Milestones for the HIMARS include, by FY97, completing fabrication of vehicle one; and, in FY98, beginning live firings at White Sands Missile Range, delivering the tactical vehicles to 3–27 Field Artillery (FA), conducting new equipment training for 3–27 FA, and participating in RFPI field exercise.

Technical barriers include developing an accurate aiming platform within weight and height constraints, integrating MLRS LRUs (fire control system, radios, air filtration, etc.) into the space available in the FMTV 5-ton truck cab, and developing a robotic reload system for rocket and missile pods.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603313A	D380/D493	9.9	6.6	5.8	1.5	0	0	0
Total		9.9	6.6	5.8	1.5	0	0	0

B.14 ***Intelligent Minefield ATD.*** This ATD will integrate new minefield munition systems and new technologies (acoustics, decision aids) into an optimized, autonomous antiarmor/antivehicle weapon system. The Intelligent Minefield will demonstrate command, control, and communications; fusion of acoustic sensor data; autonomous implementation of engagement tactics; remote control and observation; advanced acoustic sensor; and provision of combat and targeting information to the Maneuver Command System (MCS).

Specific demonstrated capabilities for the Intelligent Minefield include measures of effectiveness (MOE) and measures of success (MOS): improving wide-area munitions (WAM) performance by at least 50%, controlling a minimum of two WAM minefields (20–40 WAMS), interfacing with the MCS, detecting heavy vehicles at 2–3 km, and simultaneously tracking seven targets. The capabilities of this ATD were demonstrated in prior fiscal years. RFPI will use the acoustic sensor technology in the FY98 demonstration.

There are no technical barriers.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603004A	DL95	2.2	2.5	4.7	0	0	0	0
	Total	2.2	2.5	4.7	0	0	0	0

B.15 ***Antimateriel Warhead Flight Test.*** This DTO will demonstrate and integrate advanced laser radar (LADAR) sensor technology with a multimode warhead and advanced submunition airframe. Fabrication and integration tasks will be completed in FY97 and FY98. Full-up flight tests of the submunition with sensor and multimode warhead will be conducted in FY99. The goal of these flight tests is to discriminate targets with the LADAR sensor and successfully demonstrate warhead effectiveness when fired from a guided submunition. This supports the antimateriel munition integrating concept, and it encompasses technology that will mature in the FY99-FY02 time frame. The program will demonstrate the integration of a discriminating LADAR sensor to cue the warhead to function in the proper mode for optimum lethality. This combination of a sensor capable of discriminating a target, a warhead capable of multiple functioning modes, and the synergistic benefit of the two technologies represents a first in autonomous submunitions. The low-cost antiarmor submunition (LOCAAS) vehicle being used in the Antimateriel Warhead Flight Test (AWFT) program improves munition effectiveness through a fivefold increase in target search area, adverse weather operation, and a high kill probability for all ground mobile targets. Sortie effectiveness is enhanced by enabling multiple kills per pass with the submunition/dispensing concept. The LOCAAS concept also has affordability as one of its primary objectives, with a unit cost goal of $20,000 per submunition.

The primary program payoff is the ability to defeat the full range of ground mobile targets (tanks, trucks, surface-to-air missile systems) with a single submunition. Technology barriers are development of LADAR seeker and target classification algorithms, and development of a multimode warhead that produces three different kill mechanisms. An IPPD plan has been formulated jointly by the System Program Office and WL/MN.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603601F	670A	2.8	4.7	4.4	0.7	0	0	0
	Total	2.8	4.7	4.4	0.7	0	0	0

B.16 ***Concentric Canister Launcher ATD.*** The goal is to demonstrate, by FY99, the feasibility of a universal launching system employing concentric canisters. This can be applied to future Navy combat ships capable of firing a wide range of missiles including the Evolved Sea Sparrow Missile System (ESSM), Tomahawk, Standard Missile Blk. 4, and the Army Tactical Missile System (ATACMS). Its lightweight structure and unique gas management system allow for inherently greater and more flexible firepower on a volume basis compared with existing VLSA designs. The launching system is an array of concentric cylinders; the inner cylinder supports the weapon and guides its initial flight, while the annular space between the inner and outer cylinders provides for gas management during the launch sequence. The ability to design a concentric canister self-contained gas management system capable of successfully and safely handling both flyout and restrained firing of Tomahawk, Standard Missile Blk. 4, and ATACMS missiles will be demonstrated. This supports and provides greater firepower for naval combatants, lowers ship construction costs by using a generic manufacturing process for all surface vessel weapon launchers, and eliminates a diversity of launcher types.

Goals for the program are to reduce production costs by 25%, reduce maintenance costs by 40%, reduce manning by 50%, and reduce new missile shipboard launcher integration costs by 50%.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603217N	R0447	5.0	5.0	5.0	0	0	0	0
	Total	5.0	5.0	5.0	0	0	0	0

B.17 ***Low-Cost Missile ATD.*** This ATD addresses common deficiencies in air superiority and defense precision strike thrusts that require extended-range, high-speed missile concepts. Fasthawk will deliver weapon payloads to address the needs of the warfighter, including increased platform survivability, precision strike, low cost, longer range, and less visibility.

This DTO will demonstrate, by FY99, a unique, finless, low-drag bending annular missile body (BAMB) airframe and ramjet propulsion concept to give the Navy the capability to attack time-critical and hardened targets. In this concept, the ramjet combustor and tandem booster are connected to the frontal missile airframe by an articulating thrust vector control joint. The technical challenges demonstrated by flight tests are a robust H-infinity-based bending body control system to provide dynamically stable flight without aerodynamic control surfaces, a self-starting annular inlet with 68% pressure recovery at Mach 3.0, 60,000-ft altitude, and stable bent-body combustion during maneuvers and all flight regimes. A free-flight test of a BAMB ramjet missile configuration will be demonstrated by FY99. This provides the technologies necessary for a low-cost missile with a capability of carrying a 500-lb warhead with a block speed of Mach 3.5. This average velocity will provide significantly reduced time-to-target. Analysis shows that a weapon with this capability used in a Korean scenario would eliminate the need for over 240 aircraft sorties against time-urgent and buried targets, all in high-threat environments with a potential warfighting savings of over $250 million.

Fasthawk can be air-launched and provides a common low-cost delivery platform. The supersonic velocity provided by the Fasthawk missile will significantly reduce time to target and provide increased maneuverability and range. These attributes will provide a supersonic, low-observable, high-energy payload delivery to fixed targets, including hardened targets, eliminating the need for precision delivery by aircraft. It will result in increased launcher survivability with resultant cost savings. These technologies are also applicable to other sized missile airframes with equivalent ranges and reduced target times. It will also significantly reduce maintenance costs (standardized off-the-shelf equipment and simpler systems) and logistics costs (S/F commonality). Technology in this ATD will undergo transition to the Tomahawk Block 5 missile system. Major area defense programs that have indicated interest in this technology include Navy (PEO(CU), PEO(TAD), Aegis), Army (Corps SAM, Patriot), and Air Force.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	4.4	6.1	4.5	0	0	0	0
	Total	4.4	6.1	4.5	0	0	0	0

B.18 ***Low-Cost Precision Kill.*** This DTO will demonstrate a very low cost (~ $10,000), accurate (~1-m CEP) guidance and control retrofit package for the 2.75-inch Hydra–70 rocket. A standoff range (greater than or equal to 0.6 km) capability will be provided against specified nonheavy armor point targets often engaged in large numbers in many operational scenarios. This capability will provide for a high single-shot probability of hit (greater than 0.7) against the long-range target, exceeding the current unguided 2.75-inch rocket baseline by one or two orders of magnitude and thereby providing a 4:1 increase in stowed kills at one-third the cost per kill compared to current guided missiles.

Current plans and funding profiles for the Low-Cost Precision Kill technical base program call for hardware-in-the-loop demonstrations of at least two candidate brassboard strapdown (solid-state) guidance sections and an in-house developed 2.75-inch diameter canard control section by FY98, control test vehicle flights by FY00, and full-up proof-of-principle guided flights by FY01.

Technical barriers include unproven low-cost, producible strapdown (solid-state) mechanisms for precision guidance; a requirement for accurate, robust control of a highly rolling free rocket; the lack of small, very low cost inertial components; weight and size minimization component packaging in the 2.75-inch airframe; a limited understanding of structural, vibration, and shock considerations for guidance package retrofit to the 2.75-inch Hydra–70 rocket; and lack of standoff range target acquisition and engagement techniques to address current free-rocket launch and flight dispersions.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602303A	A214	1.2	1.2	0	0	0	0	0
0603313A	D567	0	0	0.5	5.5	4.0	0	0
	Total	1.2	1.2	0.5	5.5	4.0	0	0

B.19 ***Cruise Missile Real-Time Retargeting.*** This DTO will develop technologies for brilliant autonomous cruise missiles with onboard mission planning and control systems. The program will demonstrate, by FY00, a brassboard real-time guidance and control system with an associated laser radar (LADAR) sensor and with associated mission planning to demonstrate distributed guidance technology needed to provide (1) immediate launch-on-coordinates capability for weapons; (2) in-flight, onboard decision making to provide in-flight coordinated attack against fixed and mobile targets, including the ability to switch alternative targets given information by either external or internal sources that an individual cruise missile's primary target has been damaged or destroyed by a preceding cruise missile; (3) precise aimpoint selection; and (4) battle damage indication. The LADAR seeker to be demonstrated in this program is being developed jointly with the Air Force. The seeker is anticipated to cost 10% of the imaging IR systems currently deployed while providing a greater than 33% reduction in future cruise missile seeker/guidance and control systems cost. In-flight, onboard route replanning capability and onboard real-time autonomous decision-making capability will reduce the number of cruise missiles per target by a factor of one-third and thus reduce the overall life-cycle costs of future cruise missile systems.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	5.7	5.5	6.1	4.5	0	0	0
	Total	5.7	5.5	6.1	4.5	0	0	0

B.21 ***Miniaturized Munition Technology Guided Flight Tests***. This DTO will demonstrate, by FY02, the effectiveness of a small, 250-lb-class munition with an enhanced fragmentation/enhanced blast warhead, antijam Global Positioning System (GPS)/Inertial Navigation System (INS) guidance, and a laser radar (LADAR) terminal seeker. The goal is to demonstrate a small munition's capability to destroy a majority of fixed target threats. Its small package will allow a three- to fourfold increase in aircraft loadout, thereby increasing three to four times the number of targets destroyed on a single sortie. Given a fixed number of aircraft, this will increase the tempo of the war and allow more targets to be destroyed in a shorter amount of time, providing the potential to shorten the war. The smaller logistic footprint will allow airlifting of more munitions in a shorter amount of time. The smaller munition will also give future aircraft designers more flexibility in sizing their weapons bays and allow future stealth aircraft to carry more firepower in internal weapon bays and maintain their effectiveness against the majority of fixed targets.

Several areas will be demonstrated, including (1) an enhanced fragmentation blast warhead with an explosive 1.5 times the energy in tritonal; (2) the warhead in conjunction with the Hard Target Smart Fuze's ability to sense layers/voids and detonate at the appropriate location to ensure the warhead's effectiveness against 85% of the JDAM MK83/BLU–109 2010 fixed-target threats; (3) an antijam GPS with a 120-dB jam-to-signal ratio (50 dB better than commercial systems) effective up to 1 nmi from a 100-kW jammer; and (4) a less than 3-meter accuracy (400% improvement over JDAM accuracy) using a LADAR terminal seeker.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603601F	670B	0	0.1	2.5	3.0	3.0	2.3	0
	Total	0	0.1	2.5	3.0	3.0	2.3	0

COMBAT IDENTIFICATION

COMBAT IDENTIFICATION

C.01 ***Battlefield Combat Identification ATD.*** The Battlefield Combat Identification (BCID) ATD is aimed at solving the combat identification (ID) problem underscored by the lessons learned from Operation Desert Storm. The ATD provides the Army's technology options for the joint combat ID air-to-ground and ground-to-ground ACTD. Efforts in this ATD build upon the Battlefield Combat Identification System (BCIS) near-term solution presently being developed for vehicle platforms (a millimeter-wave, question-and-answer type, target ID system) and validate the architecture for a comprehensive air-to-ground and ground-to-ground, BCIS-compatible system including the dismounted soldier. Battle Lab Warfighting Experiments (BLWEs) in FY95 assessed requirements and several concepts for the dismounted soldier. BLWEs in FY96 provided the foundation for a joint ACTD and several concepts for integrated air-to-ground and ground-to-ground applications, including situational awareness through the gunner's sight. Probability of correct ID of friendly platforms will be increased from 90% (BCIS baseline) to 99% at 1.5 times the effective range of the weapon, and position location accuracy of 100 m or better will be demonstrated. In FY97, the ATD will demonstrate an enhanced BCIS digital datalink on combat vehicle platforms in conjunction with the Task Force XXI field exercise and combat ID for air-to-ground operations. In FY98, as part of the Digitized Division exercise, BCID ATD will demonstrate advanced concepts for enhanced ID that leverage target acquisition sensors. Reduction of target ID timelines by at least a factor of three will be demonstrated. Also in FY98, the ATD will demonstrate miniaturized hardware for the dismounted soldier as part of the 21st Century Land Warrior effort.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603772A	D281	7.1	3.4	0	0	0	0	0
0602120A	AH15	3.7	3.5	3.5	3.4	3.6	3.7	3.8
	Total	10.8	6.9	3.5	3.4	3.6	3.7	3.8

C.02 ***Combat Identification ACTD.*** The CID ACTD is designed to assess technology concepts that potentially provide an affordable, effective air-to-ground combat identification capability interoperable with the current Battlefield Combat Identification System (BCIS) ground-to-ground solution or other ground-to-ground system concepts. The ACTD builds upon the architectural framework of the DoD Combat Identification Task Force. The ACTD is aimed at increasing combat effectiveness while reducing fratricide. A series of technical and operational exercises is planned to quantify key parameters such as probability of correct identification, time to identification, range of identification, spatial discrimination, and system capacity (in terms of user density) for the various concept alternatives. Two operational warfighting exercises in FY97 will measure operational capabilities. In FY97, these capabilities will be demonstrated and evaluated in the Army Warfighter Experiment Task Force XXI and by the All-Service Combat Identification Evaluation Team (ASCIET). In FY98, the data collected will be analyzed to support the battlefield combat identification analysis of alternatives and subsequent program decisions.

The CID ACTD provides the user an operational capability, the means to evaluate the potential new capability in terms of its military utility, and a sound basis for adapting the warfighting concept of operation to maximize effectiveness of the new capability. This ACTD includes hardware funded under non-S&T PEs, including the Army Battlefield Combat ID System, Navy Situation Awareness Beacon with Reply (SABER) project, and Air Force Situation Awareness Data Link (SADL) project. One objective is to demonstrate an interoperable air-to-ground and ground-to-ground combat identification capability with a minimum probability of correct identification of 0.90. Additionally, identification will be demonstrated effectively at 1.5 times the effective range of the weapon. The ACTD will comprise numerous cooperative CID systems (both question-and-answer and digital radios) and one noncooperative technique (RF emitter geolocation and real-time specific emitter identification (SEI)).

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602120A	AH15	1.0	0	0	0	0	0	0
0603772A	D281	4.4	0	0	0	0	0	0
0603742F	F32	1.0	0	0	0	0	0	0
0603270F	691X	2.0	0.2	0	0	0	0	0
0603750D	P523	15.3	4.0	4.0	0	0	0	0
	Total	23.7	4.2	4.0	0	0	0	0

C.03 ***Advanced Identification ATD.*** The objective of this ATD is to develop and demonstrate an advanced combat identification capability for use on current and next-generation aircraft. This joint Air Force–Navy ATD will leverage the investment already made in multiple science and technology programs.

Multisensor/multifeature fusion algorithm developments are being examined by the Air Force Air Target Algorithm Development (ATAD) program for air targets, and will be tested in the ATAD flight demonstration in FY98. The Navy Noncooperative Air Target Identification program provides advanced inverse synthetic aperture radar imaging techniques for air targets via an adaptive-range Doppler imaging process (roofhouse demonstration in FY99). Exit criteria for air target identification (20 classes) under this DTO are (1) declaration probability of 85% and (2) identification confidence probability of 99%. For surface targets, the DARPA/Air Force Moving and Stationary Target Acquisition and Recognition (MSTAR) program is developing model-driven automatic target recognition (ATR) synthetic aperture radar technologies. The Navy Littoral Surveillance/Moving Target Recognition program will provide a demonstration of imaging small craft (flight demonstration in FY98). The Air Force Air-to-Ground Radar Imaging program will demonstrate an advanced one-dimensional radar imaging/identification technique in a fire control radar (flight demonstration in FY01). Exit criteria for surface target identification under this DTO are (1) declaration probability of 85% and (2) identification confidence probability of 98%.

These radar technologies will be jointly flight tested by the Air Force and Navy. Plans are also being made for participation in the annual All-Service Combat ID Evaluation and Test exercises conducted by the Joint Combat ID Office and sponsored by GOSC-ID.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603203F	69DF	1.3	3.6	3.9	5.7	4.0	0	0
0602232N		1.6	1.8	2.0	0	0	0	0
Total		2.9	5.4	5.9	5.7	4.0	0	0

C.04 ***Enhanced Recognition and Sensing Laser Radar ATD.*** The Enhanced Recognition and Sensing Laser Radar (ERASER) ATD is aimed at improving the airborne identification process for air and ground targets through the use of active laser technologies. Efforts for this program will concentrate on integrating ERASER laser and signal processing technology into an F–117A targeting system turret for flight demonstration on a testbed aircraft. The flight demonstration technology base is directly applicable to Low-Altitude Navigation Targeting Infrared for Night (LANTIRN), Joint Strike Aircraft (JSF), and other emerging forward-looking infrared (FLIR)/designator targeting systems. ERASER-supplied target identification will complement other sources of ID from the warfighter's total ID suite. ERASER will incorporate two-dimensional laser imaging technology and CID algorithms developed for ground target identification; ATR concepts from one-dimensional radar technology will be adapted to laser wavelengths for air target ID. Evaluations in FY96 assessed current ID capability and defined ERASER requirements to complement these capabilities. In FY97, ERASER will conduct a long-range (10–20 km) field test/data collection to demonstrate functional performance and expand the database for ATR. The ERASER short-wave infrared camera will be delivered and integrated in FY98. In FY99, a tower test will be followed by flight demonstration of ERASER technology at militarily significant ranges. Exit criteria for ERASER surface target identification are (1) declaration probability of 85% and (2) identification confidence probability of 98%.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603203F	665A	0.3	1.3	2.7	3.3	3.0	0	0
	Total	0.3	1.3	2.7	3.3	3.0	0	0

C.06 ***Specific Emitter Identification ATD.*** Specific Emitter Identification (SEI) technology enables passive identification of platforms emitting radio frequency signals, thus enhancing ocean surveillance and combat ID capabilities. The warfighter has a highly reliable method of passively identifying emitters and hence knows the identity of each individual ship and aircraft. This capability allows for the correct identification and surgical removal of threat systems. At present, both coastal and open ocean surveillance operations are being conducted using prototype SEI equipment, including monitoring maritime shipping in support of embargo enforcement and tracking the movement of military assets. In FY97, algorithms will be developed to perform automatic platform recognition using SEI as a primary input. This software development will reduce the amount of operator input required by 50% and yield more accurate matches between the new signals received and the library entries. In FY98, miniaturization of the SEI processor unit will be completed, resulting in a factor of 100 reduction from the current size. Algorithms are being developed to mathematically account for signal distortion caused by the slight differences in each SEI receiver, which can cloud or mask the unintentional modulation on pulse signature. This will allow a loosening of receiver specifications, with a goal of a 50% reduction in receiver cost.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602270N		0.8	0.9	0.9	1.0	1.0	1.1	0
0603270N	E2194	1.0	0.7	0.4	0.4	0.4	0.4	0
Total		1.8	1.6	1.3	1.4	1.4	1.5	0

JOINT THEATER MISSILE DEFENSE

JOINT THEATER MISSILE DEFENSE

D.02 ***Integrated Sensor/Data Fusion Demonstration.*** In anticipation of future requirements for more sophisticated surveillance sensors for theater missile defense, the Ballistic Missile Defense Organization (BMDO) is supporting an Advanced Sensor Technology Program (ASTP) and Integrated Sensor/Data Fusion Demonstration. The principal objective of this program is technology development culminating in airborne demonstrations of a multispectral sensor suite consisting of a radar, IR sensor, and eyesafe laser radar (LADAR). Individual sensor data streams will be fused in real time to provide all-weather day/night capabilities. The goal is to develop sensor technology and demonstrate fused-sensor technology for timely, long-range missile launch detection/warning and missile defense cueing, precise tracking for impact point prediction, launch point estimation, target identification and discrimination, and interceptor fire control functional support.

Technologies that are being pursued include multiple quantum well focal plane arrays (FPAs) to provide acquisition of targets in a cluttered background through operation of simultaneous multicolor, large format (1024 x 1024), highly uniform (less than 1% nonuniformity) detector arrays (as opposed to the smaller format (256 x 256), single color, less uniform (8%) FPAs currently available); smart focal plane arrays to preprocess signals on or near the FPA (versus off-FPA) to reduce signal processor throughput and mass; eye-safe LADAR to provide three-dimensional imaging capability beyond a 100-km range in the atmosphere in a reduced package (less than 20 kg versus more than 50 kg state-of-the-art); wide-angle search radar for all-weather theater ballistic missile booster surveillance; and tracking and discrimination data fusion algorithms. Both the ASTP and the Integrated Sensor/Data Fusion Demonstration will develop and demonstrate these technologies in laboratory and ground tests prior to an airborne technology demonstration. Complementary technology efforts on dual-band, cooled IR FPAs using layered mercury-cadmium-telluride technology and highly uniform uncooled FPAs are underway as described in DTO SE.33.01, Advanced Focal Plane Array Technology.

Ground test demonstration of multiple sensor data fusion capability using fault-tolerant neural network image processors will take place in FY99. The first airborne demonstration has been scheduled for FY01. The fused sensor suite will be used to observe theater and strategic ballistic missile targets of opportunity. Additionally, it will perform launch detection/warning, interceptor and other defense cueing, precise tracking, impact point prediction, launch point estimation, and discrimination.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602173C	1651	3.0	3.0	2.0	0	0	0	0
0603173C	1161	19.0	18.0	16.0	15.0	5.0	5.0	0
0603173C	1270	1.0	1.0	1.0	0	1.0	1.0	0
	Total	23.0	22.0	19.0	15.0	6.0	6.0	0

D.03 ***Discriminating Interceptor Technology Program***. Advanced ballistic missile defense (BMD) interceptors must discriminate with high confidence between real targets and other objects such as decoys and debris for effectiveness in an electronic countermeasures (ECM) environment, or against reentry vehicles accompanied by decoys. An interceptor employing these technologies, used in an architecture including ground-based radar and space-based infrared satellites, could potentially protect U.S. cities from ballistic missile attack and protect fighting forces from theater ballistic missiles. Simulation results show that, depending upon the attack scenario, the single-shot kill probability (P_k) can increase by as much as a factor of nine after the addition of advanced interceptor discrimination capability (P_k increases from 0.1 to 0.95). An interceptor mass growth of 25% will occur and the interceptor alone will be more expensive than without advanced discrimination. However, the overall system cost will decrease because only one interceptor will be fired instead of two or three to meet system effectiveness requirements.

The following technologies are necessary for interceptor discrimination: lightweight laser radar to provide 3D imaging capability leading to long-range discrimination with 20-cm range resolution and 2-cm/s velocity resolution in a 5–10-kg package (an order of magnitude smaller than can be achieved with present technology); simultaneous multispectral long-wavelength infrared (LWIR) focal plane arrays (FPAs) to extend acquisition of cold targets from 500 km to 800 km by increasing specific detectivity by a factor of two; highly uniform FPAs as discussed in DTO D.02; and data fusion techniques to combine the outputs of active and passive sensors in a miniaturized package providing a fourfold improvement over the state of the art in terms of GFLOPS/watt and GFLOPS/dollar, and a seventyfold improvement in packaging density (700 GFLOPS/ft^3). The Discriminating Interceptor Technology Program will develop and demonstrate these technologies in laboratory tests and low-cost interceptor flight tests. Technology needs for multispectral and highly uniform FPAs are also being addressed by complementary technology efforts under DTO SE.33.01, Advanced Focal Plane Array Technology. Systems benefiting from this technology are the Exoatmospheric Kill Vehicle, Theater High-Altitude Air Defense System (THAAD), and the Navy Upper Tier Interceptor.

Milestones and demonstrations include building and bench testing prototype LADARs, and lab testing simultaneous two-color LWIR FPA at 0.2–1.0 x 10^{12} Jones (4Q98); downselection between completing solid-state and CO_2 LADAR designs (1Q99), lab testing a fusion processor and algorithms, and building and lab testing a 10-kg prototype LADAR (4Q99); integrating a two-color passive FPA and fusion processor into a prototype shared-optics fused seeker (3Q01); lab and field testing a fused seeker (1Q02); and flight testing a fused seeker in an EKV observation package (4Q02). The first discriminating interceptor demonstration will take place in FY02. It will take advantage of the fly-along bus in a BMD core program test. This first test will observe the target, decoys, and debris and perform real-time discrimination between them.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603173C	1161	0.9	0.9	0	0.8	0.7	0	0
0603173C	1270	16.0	14.0	12.0	12.0	14.0	14.0	15.0
Total		16.9	14.9	12.0	12.8	14.7	14.0	15.0

D.04 ***Advanced X-Band Radar Demonstration.*** By FY00, this DTO will demonstrate a fivefold increase in output power of solid-state transmit/receive (T/R) monolithic microwave integrated circuits (MMICs) operating at 10 GHz (X-band). Current gallium arsenide (GaAs)-based MMIC technology provides approximately 10 W peak output power. This output power can be dramatically increased using advanced GaAs designs such as metal semiconductor field effect transistors (FETs), pseudomorphic high-electron mobility FETs, heterogeneous FETs, and wide-bandgap devices. Advanced MMIC module packaging technologies such as stack module designs can reduce the overall occupied volume of the MMIC T/R modules, improving the efficiency of the device and its manufacturability, as well as the transportability of the system using the MMIC chips. Complementary technology efforts are being conducted under DTO SE.27.01, Microwave SiC High-Power Amplifiers. Technical requirements for the advanced T/R modules are X-band operation, 40-W output power, 40% efficiency, 1-GHz bandwidth, 1,000-hour operating time at 250°C, and size suitable for placement into a fully populated X-band phased array.

The program will begin in the second quarter of FY97. Demonstration of the advanced module will take place in the fourth quarter of FY00, and designs for the Theater High-Altitude Area Defense (THAAD) ground-based radar (GBR) and the National Missile Defense (NMD) GBR will be complete by the end of FY01. The radar module development program will produce form, fit, and function replacement T/R modules for the THAAD GBR and the NMD GBR with greatly increased power, efficiency, and lifetime. The program will be completed in time for pre-planned product improvement (P^3I) insertion into the THAAD GBR, to take place in FY02–FY04. It will allow a 40% increase in GBR range.

The various MMIC technologies are targeted for use in the THAAD GBR and the NMD GBR, which are both X-band multielement radars. Advanced solid-state T/R modules for the THAAD and NMD GBRs will improve their target detection capabilities by roughly a factor of two, allow them to discriminate various threats from one another by improving their sensitivities by a factor of five, and allow them to operate in a burnthrough mode to overcome jamming and radio frequency interference. The Army's PEO Missile Defense is the supporting customer.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602173C	1651	4.2	4.5	4.5	4.5	0	0	0
	Total	4.2	4.5	4.5	4.5	0	0	0

D.05 ***Advanced Space Surveillance.*** This DTO will integrate advanced satellite technologies into a flight demonstration platform that can perform precision surveillance, acquisition, and tracking of sophisticated ballistic missile targets. In the multimode sensors area, the program will develop unique, organic-based, and novel optical materials for BMDO sensors. Milestones include the following: by 4Q98, delivery of an organic/polymeric data processing device; by 4Q99, conduct of a preliminary design review (PDR) for an operational focal plane array (FPA); and by 4Q01, availability of an operational UV/IR FPA. In the multisensor data fusion area, the program will utilize assets at the Innovative Sciences and Technology Evaluation Facility (ISTEF) (both fixed and mobile sensors) to develop and demonstrate advanced sensor fusion concepts and algorithms. Milestones include the following: by 3Q97, integration of a three-dimensional chip stack version of VIGILANTE surveillance/tracking processor electronics; by 3Q98, a ground demonstration of VIGILANTE; by 3Q99, upgraded ISTEF sensors to provide a testbed for advanced data fusion algorithms; and by 1Q01, an end-to-end demonstration of VIGILANTE II.

The Advanced Space Surveillance DTO will develop a 10-GB/s data rate laser communicator with lightweight, low-power transceivers suitable for platforms such as space vehicles. The program will develop high-density wavelength-division multiplexing waveguide components for very large bandwidth supercomputer links and distributed massively parallel computer networks. This DTO will provide a hundredfold processing increase over the current THAAD BMC^3 capability. Milestones include the following: by 3Q97, completion of a next-generation Lasercom terminal; by 4Q98, demonstration of a 10-element array of optical amplifier and array modulators; by 1Q99, joint experiments with the United Kingdom on Space Test Research Vehicle–2 (STRV–2); by 3Q00, demonstration of terabit-bandwidth communications with eight interconnected commercial off-the-shelf (COTS) workstations; and in 2Q01, a ground-to-air test of the next-generation Lasercom.

This program will fabricate, assemble, and test a 2.6-kW photovoltaic solar array (SCARLET–2) for use on NASA's New Millenium Program spacecraft; and design and develop a SCARLET–3 solar array that will provide 70 W/kg for 7 years at 1,500 km. SCARLET technology goals include the following: specific power of 50–80 W/kg (SCARLET–2 is 50 W/kg at 2.6 kW); cell efficiency of 24% (SCARLET–2) to 30% (advanced technology); array voltage up to 500 V (SCARLET–2 is 100 V); and an array cost of less than $700/watt with high-efficiency cells and less than $500/watt with GaAs cells. Milestones include the following: by 4Q97, completion of qualification testing and delivery of SCARLET–2 arrays to the Jet Propulsion Laboratory; by 3Q01, ground testing of SCARLET–3; and by 4Q01, readiness of system for spacecraft integration.

The program will conduct a flight test of a Russian Hall Effect Thruster (RHETT) system. RHETT technology goals include the following: specific impulse of 1,600 s, efficiency of 50%, power level of 1.5 kW into system, system mass less than 20 kg (without propellant and tank), and a lifetime greater than 5,000 hours. Technologies include low-cost, flexible-design power processing units (PPUs); thruster lifetime improvement concepts; and low-cost xenon feed system components. Milestones include the following: by 1Q97, delivery of flight-qualified RHETT II hardware to the Naval Research Laboratory; by 4Q97, launch of spacecraft with RHETT II and commencement of on-orbit tests; by 2Q98, delivery of prototypes of advanced PPU and feed systems; and by 4Q00, laboratory demonstration of a U.S.-developed Hall effect thruster based on the Russian design.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602173C	1651	7.0	7.5	7.5	7.0	7.0	0	0
0603173C	1161	0.9	0.9	0.9	1.0	0	1.0	1.0
Total		7.9	8.4	8.4	8.0	7.0	1.0	1.0

D.08 ***Atmospheric Interceptor Technology***. Hypersonic hit-to-kill intercepts of theater ballistic missiles (TBMs) within the atmosphere provide significantly expanded areas of protected coverage over current systems, take advantage of atmospheric stripping of decoys to reduce countermeasure discrimination requirements, provide a capability against TBMs whose trajectories remain in the atmosphere, and permit intercepts of TBMs in the boost phase of their trajectories. The Atmospheric Interceptor Technology (AIT) program focuses on the development, integration, and demonstration of lightweight kill vehicle technologies that can withstand the high thermal stress environment of this flight regime, including intercepts at 25-km altitude with interceptor velocities of 4 km/s. Lightweight technologies are critical for incorporating these kill vehicles in existing/planned theater missile defense (TMD) systems as block upgrades or preplanned product improvements to preserve service weapon system infrastructures. AIT technologies being developed are applicable to advanced Navy theater-wide defense, advanced THAAD, the Medium Extended Air Defense System (MEADS), and unmanned aerial vehicle/boost phase intercept (UAV/BPI). Planned demonstrations will provide (1) new capabilities with reduced costs/risks compared with current interceptor weapon systems, and enhancements to other interceptors under development; (2) reduction of technical risks and costs in support of acquisition programs through direct technology insertions; and (3) technical solutions to provide TMD interceptor capabilities for contingencies not currently addressed by the TMD system programs. The technology development effort emphasizes cooled windows/forebodies, strapdown infrared seekers, lightweight composite vehicle airframe structures, and solid divert and attitude control systems (DACSs). AIT is the only atmospheric kill vehicle technology program within BMDO.

Cooled forebodies have been demonstrated in ground testing to withstand the aerothermal loads of the hypersonic endoatmospheric flight regime. Aero-optic effects of a hypersonic flowfield on an externally helium-cooled forebody/window concept have been measured in ground testing under conditions duplicating the flight environment and have been consistent with analytical predictions. Strapdown seeker components have been demonstrated in ground tests, and a prototype seeker is planned for demonstration in ground tests in FY97. Assuming a fully funded program, an integrated kill vehicle will be available for ground test in FY99 with hit-to-kill flight test demonstrations completed by FY01. With current funding, a prototype strapdown infrared seeker and cooled window/forebody will be completed, and minimal development will continue on other critical components throughout the life of the program.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603173C	1270	47.4	4.9	5.0	4.9	5.7	0	0
	Total	47.4	4.9	5.0	4.9	5.7	0	0

MILITARY OPERATIONS IN URBAN TERRAIN

MILITARY OPERATIONS IN URBAN TERRAIN

E.01 ***Small Unit Operations TD.*** By FY00, Small Unit Operations (SUO) will demonstrate the capability to provide (1) scaleable, nonhierarchical networks with robust communications to enhance decision making at all echelons involved in MOUT operations; (2) situation awareness for tactical-level combatants to enhance collaborative planning from the battalion level down to the individual soldier or Marine; (3) tasking and control of multiple autonomous systems with multiagent tasking and planning algorithms, integrated reflective and reactive planning, and automated tasking decomposition strategies; and (4) an internetted and arrayed advanced sensor capability, dynamically linked with situational awareness and tasking capability, to extend the tactical local area awareness and provide a flexible, precision targeting capability integrated into the communications and geolocation architecture. By FY01, SUO will integrate weapon/fire location processing and demonstrate the capability to detect and accurately locate hostile artillery/mortar/sniper fire.

Specific capabilities to be demonstrated include (1) wireless communications providing voice, data, video, and graphics (operating in a severe multipath environment) with a two- to fivefold range increase and a greater than 40-dB process gain in a lightweight (less than 1.5 kg with a 2-day battery supply) package integrated with geolocation and navigation technologies capable of better than 3-m location accuracy that operate reliably in built-up environments with intermittent or obscured Global Positioning System (GPS) data; (2) a precision clock with rapid startup (2–5 seconds) and high stability (1×10^{-12}) to provide precision geolocation and navigation for comprehensive situational awareness; (3) sensor technology (with a maximum volume of 1 ft^3, an operating life of at least 1 day, a range of 30 km) to detect, identify, locate, and report targets; and (4) a necessary logic component to integrate and manipulate sensor inputs to provide meaningful targeting information for the warfighter.

The enabling technologies to be exploited include enhanced packaging; forward error correction coding; advanced protocols; diverse antenna technologies; multichannel, variable bandwidth, advanced modulation techniques; and GPS precision. Technology barriers that must be overcome are lightweight power sources, RF propagation in restrictive environments, GPS acquisition in restrictive environments, and digital Loran.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603764E	LNW-02	41.9	53.6	58.4	71.4	77.8	68.0	0
	Total	41.9	53.6	58.4	71.4	77.8	68.0	0

E.02 ***Military Operations in Urban Terrain ACTD.*** The challenge for the MOUT ACTD is the identification and integration of existing and emerging technologies for enhanced command, control, communications, computers, and intelligence (C^4I); engagement; and force protection in the restrictive urban environment. This effort does not develop technologies, but provides the environment and integrates components into a system of systems for evaluation in a stressing situation. Key programs providing technologies for the ACTD are detailed in DTOs E.01, E.03, and E.04. Phase I (FY97–FY98) will complete instrumentation, baseline experiments, validation of measures of effectiveness, and experiments with technologies involving nondevelopment items (NDI), commercial off-the-shelf (COTS) items, and government off-the-shelf (GOTS) items. Phase II (FY99–FY00) will complete experimentation with upgraded hardware/ software. Residuals include a company-level set of successfully demonstrated equipment. The specific capabilities to be integrated are those already demonstrated in previous TDs and ATDs but as yet untested.

MOUT C^4I systems integration and interpretability will increase situational awareness by 50% using advanced sensor capabilities and a seamless, nonhierarchical, adaptive network system to give commanders and warfighters the ability to conduct multimedia communications through buildings and other non-line-of-sight obstacles. MOUT engagement will demonstrate both lethal and nonlethal technologies. MOUT force protection will be improved 20% via demonstration of new ballistic protection, countersurveillance, combat identification, countersniper, and individual medical technologies.

Modeling and simulation will enhance MOUT training and mission rehearsal, evaluate MANPRINT, refine operational concepts, and evaluate command and control. Installation of distributed interactive simulation/high-level architecture instrumentation for collection of individual performance data during field experiments will be complete by FY98. By FY98, data to support validation of models and simulations, analysis of new/modified tactics, techniques and procedures (TTP), and analysis of test results will be complete, while reducing these costs by 70%. By FY98, requirements/measures of performance will be defined for rapidly transportable/ configurable simulations and models for use by brigade/battalion commanders, staffs, and leaders to plan and rehearse MOUT missions in unfamiliar terrain, reducing the time/cost for mission rehearsal by 50%. By FY00, the program will demonstrate simulations that support the mission rehearsal and training of small unit leaders in MOUT TTP. Enabling technologies to be exploited can be found in individual DTAP DTOs (Human Systems, Weapons Systems and Information Systems) as well as JWSTP DTOs. There are no technological barriers to this ACTD.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603001A	D393	0	20.3	21.2	21.0	2.0	2.0	0
0603750D	P523	1.2	2.5	0	0	0	0	0
	Total	1.2	22.8	21.2	21.0	2.0	2.0	0

E.03 ***Objective Individual Combat Weapon ATD.*** The OICW ATD will demonstrate by FY99 affordable, high-payoff, individual weapon technologies that yield dramatically improved hit probability, lethality, and operational capability through the use of air-bursting munitions, kinetic energy projectiles, and advanced fire control to determine operational utility and technological maturity. OICW will produce decisively violent and suppressive target effects. It will provide the warfighter the ability to effectively acquire, engage, and incapacitate personnel targets in all operational scenarios, at extended ranges, in defilade, and in reduced visibility conditions (night/all-weather). The OICW concept will replace current M16 rifles, M203 grenade launchers, night vision devices, and laser rangefinders with a single integrated system with enhanced operational capability and increased effectiveness.

Specific capabilities to be demonstrated include at least a 50% probability of incapacitation against individual targets to 300 m, a 20% probability of incapacitation against defilade targets, and detection of targets to 1,000 m at night and in reduced visibility conditions. Enabling technologies to be exploited are advanced opto-electronic video sighting, target tracking/detection and computerized aimpoint displacement, precision laser rangefinding, modularized thermal sighting, electronic target handoff, and an efficient air-bursting munition.

There are no technology barriers to the current program. The OICW concept represents an integration of existing technologies into a system offering new capabilities and significant operational benefits. Areas of technical concern include accurate laser ranging, efficient fragmentation, systems integration, and weight minimization.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603607A	D627	3.5	3.4	3.0	0	0	0	0
0603640M	C2223	1.1	1.2	0.6	0	0	0	0
	Total	4.6	4.6	3.6	0	0	0	0

E.04 ***Non-Lethal Weapons Technical Demonstration.*** The Non-Lethal Weapons (NLW) Program will investigate and develop enhanced capabilities to deliver non-lethal products developed under the ongoing non-lethal weapons program. The main technology thrust of the NLW is to evaluate the ability to employ non-lethal weapons from standoff ranges in mid-intensity conflict and MOUT environments via unmanned aerial vehicles. Two delivery capabilities will be developed: a remotely activated payload door and a flare dispenser. The payload door system will be used to dispense irritant grenades and entanglements/barriers. Pyrotechnic irritant cartridges and acoustic whistles will be developed that can be remotely dispensed from a standard Navy flare dispenser. The program goal is to demonstrate the ability to clear civilians out of an area 75 x 30 m from a standoff distance measured in kilometers. The measure of success will be a circular area probable of 25 m from a distance of 25 km.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602624A	AH23	0.6	0.6	0.4	0.3	0.2	0	0
0602618A	AH80	0.5	0.6	0	0	0	0	0
	Total	1.1	1.2	0.4	0.3	0.2	0	0

JOINT READINESS AND LOGISTICS

JOINT READINESS AND LOGISTICS

F.01 ***Synthetic Theater of War ACTD.*** The Synthetic Theater of War (STOW) ACTD will improve the quality of simulations by developing representations of combat actions resolved at the weapon system level, command and control behaviors, and high-resolution dynamic environments that include tactically significant environmental effects. STOW will improve simulation training effectiveness and flexibility by interfacing simulations with operational C^4I systems and by integrating distributed live, virtual, and constructive simulations. A goal is to reduce the overhead cost of simulation by developing knowledge-based synthetic forces, faster database builds, and improved information transfer among participants. Significant technical challenges for the STOW 97 ACTD include scaleability of large, entity-based exercises; real-time, object-oriented simulation run time infrastructure; security of distributed simulation over ATM multicast networks; simulation of robust synthetic force and command force behaviors; and correlated multiresolution databases.

FY97 goals include demonstrating scaleability to support, in real time, 10,000 to 15,000 entities per simulation exercise; extending command forces (CFOR) to the battalion level or equivalent in all services; developing intelligent synthetic force platforms for rotary- and fixed-wing aircraft, ships, and individual combatants; implementing new standardized representations of synthetic environment databases; optimizing terrain representations for triangulated irregular networks and for large geographic regions; demonstrating key agile encryption systems for ATM networks and dynamic multicasting software and hardware to support thousands of multicast groups; and developing prototype scenario generation and distributed exercise control technologies. FY98 goals include demonstrating the STOW operational prototype in USACOM's Unified Endeavor 98–1 exercise, to include both Joint Task Force (JTF) training and mission rehearsal capabilities; and using parallel processor computers to demonstrate scaleability to support 50,000 entities per simulation exercise. During FY98 and FY99, STOW will provide system support and enhancements for USACOM joint training and mission rehearsal, and transition lessons learned from warfighter use of STOW technology, along with STOW technology improvements, to JSIMS and its service components.

Expected payoffs from the STOW 97 ACTD include new capabilities for mission rehearsal and JTF training; operational interfaces between the STOW synthetic battlespace and real-world C^4I systems; reducing required exercise support personnel through the use of company- and battalion-level synthetic command entities and new exercise generation and initialization techniques.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603761E	CST-01	34.3	13.5	13.8	0	0	0	0
0603750D	P523	4.0	2.0	2.0	0	0	0	0
	Total	38.3	15.5	15.8	0	0	0	0

F.02 ***Advanced Joint Planning ACTD.*** The AJP ACTD will provide USACOM, Joint Staff, and other CINCs with an increased ability to rapidly plan, package, and deploy forces to multiple regional conflicts. The AJP ACTD will develop, demonstrate, and establish an enhanced command, control, communications, and computer (C^4) planning capability. The program focuses on three primary areas: force readiness and deployment planning, force employment planning, and force rehearsal and evaluation. The program will adapt the technologies developed by the Joint Task Force Advanced Technology Demonstration (e.g., architecture, application, servers, and schema) and other DARPA initiatives for configuration into USACOM's C^4 environment. Emerging C^4 software tools will be tailored to primary areas of application and then integrated, employing a CONOPS developed as a part of this program. Close interaction between the developers, sustainers, and users will enhance the utility and transition of the resulting capability. This new functionality will provide a supported leave-behind capability at USACOM before undergoing transition through the DISA Global Command and Control System (GCCS) Leading Edge Services (LES) into the CCCS core service for application with other users.

The implementation phase (FY94–97) focused on readiness and deployment analysis, force employment planning, and force rehearsal and evaluation initiatives. During the support phase (FY97–98), this effort will undergo transition to the GCCS LES subsequent to a period of leave-behind maintenance support for readiness and deployment analysis, force employment planning, and force rehearsal and evaluation tools. Overall performance goals are to reduce CINC planning cycles from weeks to days or hours for crises and from several weeks to less than a week for major deployments. The warfighter will be afforded a set of user-defined, key automated planning functions providing rapid visibility to readiness; needed tools for force deployment; and employment planning, rehearsal, and evaluation.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603760E	CCC-01	17.5	3.7	0	0	0	0	0
0603750D	P523	4.0	2.0	2.0	0	0	0	0
	Total	21.5	5.7	2.0	0	0	0	0

F.04 ***Joint Training Readiness.*** By FY01, this DTO will effect the transition of advanced joint-force performance assessment and feedback tools for estimating training proficiency and training readiness. Tools include techniques and metrics for assessing how well joint forces communicate, coordinate, and synchronize resources and firepower to achieve joint mission essential tasks. One technical challenge is that existing tools, developed mostly for individual services, are subjective and difficult to aggregate for joint use. A related challenge is that simulation and modeling environments lack the methodologies and instrumentation for collecting and processing such training data. The service collaboration in this DTO will develop new tools and test them in joint operational training exercises that leverage large investments in distributed synthetic environments, modeling, and simulation. These tests use the fire support mission (air, ground, sea, and C^4I). Metrics of success include a 30% reduction in the time required to achieve training readiness, increased precision in measuring it, and a 50% increase in the number of warfighting tasks demonstrated effectively during exercises.

By FY98, the program will develop and test procedures and related instrumentation for conducting and evaluating fire support training. The FY99 goal is to develop and evaluate guidelines for planning and conducting systematic, vertical (multisite, multiservice, multiechelon) after-action reviews and in-process training reviews. By FY00, the program will demonstrate methods for linking performance in joint training exercises to estimates of readiness, and for using performance and assessment data in cost-effectiveness evaluations to guide joint training policy and resources.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603007A		0.6	0.6	0.6	0.6	0.6	0	0
0602205F		0.5	0.5	0.5	0.5	0	0	0
0603227F		0.4	0.4	0.6	0.5	0	0	0
0602233N		1.3	1.3	1.0	0.5	0	0	0
	Total S&T	2.8	2.8	2.7	2.1	0.6	0	0
0300900D*		1.0	1.5	1.5	0.5	0	0	0
	Total	3.8	4.3	4.2	2.6	0.6	0	0

*Non-S&T Funds

F.14 ***Joint Decision Support Tools (Joint Logistics ACTD, Phase II).*** This ACTD applies mature DoD and commercial technologies to critical logistics problems. Through information fusion, it applies joint decision support tools to reduce the logistics footprint, right-size inventories, and rapidly reprioritize and redirect combat support. This phase focuses on achieving interoperability within the logistics functional area and the Defense Information Infrastructure (DII)/common operating environment as the migration platform. It exploits the success of the logistics anchor desk developed by the Total Distribution ATD by migrating its existing decision support tools and capabilities into the joint arena with the Global Combat Support System (GCSS). It is fed by technologies developed through the Defense Advanced Research Projects Agency (DARPA) Advanced Logistics Program. During FY97–98, this ACTD will develop specific joint, integrated decision support tools to provide CINC/JTF and service/agency planners the capability to plan/replan logistics operations based on real-world asset visibility and control. These tools will support logistics operations across the entire operational spectrum—mobilization, deployment, employment, sustainment, and redeployment. They will conform to all DII standards and be accessible through the Global Command and Control System (GCCS) or through GCSS. They will access data through the Joint Total Asset Visibility, Joint Personnel Asset Visibility, Global Transportation Network, Joint Operational Planning and Execution System, or other existing/developing architectures. People, units, equipment, and supplies will be included. These solutions will be linked with other functional area initiatives such as the Advanced Joint Planning ACTD (F.02) and the Battlefield Awareness and Data Dissemination ACTD (A.07).

Specific objectives are to provide a single, near-real-time, globally available view of operational logistics data from the strategic to the tactical level; improve operational awareness, collaborative logistics planning, monitoring, and analysis tools; provide tools to enable course of action (COA) assessment, execution monitoring, and dynamic replanning within the decision cycle window; build on existing decision support tools where applicable, and identify and develop new tools where none exist; develop tools to integrate the entire spectrum of information needs, including capturing unit-level source data through the use of automated identification technologies and seeing and using data to model and simulate the warfighter's view of the battlespace; support and evaluate initiatives using a multiple-level security strategy; and demonstrate initial data interoperability through a shared data environment in coordination with GCSS efforts. The following metrics will determine success: (1) demonstrating the commander's confidence in the logistics pipeline by reducing redundant requisitions and reorders to no more than 5%; (2) reducing the cost per operation by a minimum of 10%; and (3) establishing a baseline for measuring accuracy, completeness, and timeliness of data; on-time closure of units and delivery of shipments; and incidence of cargo loss and damage.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603734A	T10	9.4	0	0	0	0	0	0
0602131M	C3100	0.3	0	0	0	0	0	0
0602702E	TT-06	0	12.5	0	0	0	0	0
	Total	9.7	12.5	0	0	0	0	0

F.15 *Real-Time Focused Logistics (Joint Logistics ACTD, Phase III).* This ACTD focuses on making logistics interoperable with operations, intelligence, and all other functional areas within a single Defense Information Infrastructure (DII), the Global Combat Support System (GCSS), and the Global Command and Control System (GCCS). It will link efforts in JL ACTD Phase II (DTO F.14, Joint Decision Support Tools (JDST)) with maturing technologies and capabilities developed under the Advanced Logistics Program (DTAP DTO IS.46). During FY99–01, this ACTD will provide a seamless information and decision support capability among all combat service support and operations functions to support the warfighter. This information interoperability will be available on any workstation (hardware independent) and on one net (the DII common operating environment (COE)), and will present one fused picture of the expanded battlespace. This ACTD expands efforts begun in JL ACTD Phase II (F.14, JDST) by supporting and evaluating initiatives using a multilevel security strategy, demonstrating initial data interoperability through a shared data environment in coordination with GCSS efforts, improving the commander's confidence in the logistics pipeline during crisis action planning and execution support to eliminate redundant requisitions, and generating timely logistics course of action (COA) analyses to remain within the decision cycle window.

JL ACTD Phase III also provides operational commanders increased combat power through greater control of the logistics pipeline; develops and demonstrates a complete, end-to-end, advanced logistics system for the planning, execution, monitoring, and rapid replanning of a major force deployment from the continental U.S. (CONUS) to in-theater final destination and return to CONUS origins; develops and demonstrates fine-grained COA evaluation with access to supporting information and analyses linked to all other segments of the war plan; demonstrates total integrated logistics infrastructure requirements for dynamic replanning; demonstrates collaborative J3/J4 interoperability via integrated DII COE workstations to support planning and execution monitoring; and effects the transition of mature technology to the DARPA/DISA Joint Program Office for eventual fielding in an integrated GCCS/GCSS (DII COE).

The following metrics will be used to determine success: (1) increasing the readiness of primary weapon systems by a minimum of 10% with a goal of 20%; (2) demonstrating confidence in the logistics pipeline by decreasing redundant requisitions and reorders to no more than 5% with a goal of zero; (3) increasing the speed with which logistics COAs can be generated to a minimum of one in 4 hours with a goal of one in 1 hour; (4) reducing the dollar value of DoD-owned supply inventories by a minimum of 20% with a goal of 32%, and reducing the volume (cubic feet) of DoD-owned supply inventories by a minimum of 30% with a goal of 40%; (5) reducing the cost per operation by a goal of 25%; (6) increasing the logistics pipeline throughput capacity by a minimum of 100% with a goal of 200%; and (7) automatically capturing "leading indicator" data and forwarding a minimum of 25% of the data captured in 1 to 3 hours, with a goal of 75% in 1 to 3 hours, for use in predictive failure estimation and advanced logistics planning and support. Using the baseline developed during JL ACTD Phase II, this ACTD will establish metrics and aggressive goals for improving accuracy, completeness, and timeliness of data; unit closure; on-time delivery of cargo and personnel; and cargo and loss damage.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
Non-S&T		0	0	10.0	10.0	10.0	0	0
Total		0	0	10.0	10.0	10.0	0	0

F.16 ***Logistics Technologies for Flexible Contingency Deployments and Operations.*** To reduce the logistics airlift requirements and footprint for deployed units, this DTO will develop, demonstrate, and effect the transition of high-leverage technology tools to support flexible and rapid contingency deployments, prediction of support asset requirements, and beddown/operations at austere field operations. Work includes equipment, cargo handling modeling, battle damage repair, wing-level logistics planning and C^2, and deployment planning and bed-down prediction and analysis tools. Programs will demonstrate more accurate battle damage repair techniques that can be implemented in deployed locations and special repair methods for engines, composites, transparencies, and low observables. Payoffs for this technology include improving the operational performance of logistics planning personnel by over 40%. Improved common support equipment and cargo handling models are anticipated to reduce airlift requirements by at least 20%. Aircraft battle damage repair technologies will dramatically reduce repair times by 40%, increasing the number of aircraft available to perform combat sorties. By FY97, preliminary design of modular aircraft ground power support equipment to significantly reduce logistics airlift requirements and support reduced footprints for deployments will be completed; and live-fire extinguishing testing of solid-propellant gas generators will be accomplished, including transition of design data to Air Force and Navy aircraft development program offices. By FY98, the design for LOGCAT will be completed, and the demonstration system will be developed and tested by the end of FY99. These data will provide low-cost/non-ODS alternatives for aircraft fire suppression. First-article advanced computer logistics deployment support planning tools also will be demonstrated in direct support of multiple DoD agencies and operating MAJCOMs, providing faster and more accurate integrated deployment planning, asset prediction, and significant savings in deployment and sustainment costs.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603106F	2745	1.5	1.0	1.0	0	0	0	0
	Total	1.5	1.0	1.0	0	0	0	0

F.17 ***Advanced Amphibious Logistics and Seabasing for Expeditionary Force Operations ATD.*** This DTO will develop and demonstrate advanced seabase sustainment and combat service support technologies to support emerging operational concepts. Objectives include developing new warfighter seabase interface concepts for enhanced joint force and allied interoperability; analyzing and documenting future seabasing platform concepts to improve efficient support of Naval Expeditionary Force and Amphibious Ready Group (ARG) reinforcement, sustainment, and underway replenishment; developing and demonstrating technologies to improve seabase operational efficiency, reduce manpower requirements, and increase intermodal throughput capacity by 25–50%; developing and integrating common operating environment C^2 architectures and tactical logistics (TACLOG) C^2 improvements for inter- and intra-seabase total asset visibility and tactical logistics for all classes of supply. The program will focus on enabling technologies to allow reduced expeditionary force footprint ashore by up to 25% while supporting from a seabase; and will explore cost and operational efficiency gains from advanced container throughput handling, smart warehousing, mission tailoring of all class of supply loads, and onboard modular suiting concepts. The program will assess the feasibility of ARG/MPF reductions in operational support costs by 10–50%.

The FY97 goal is to refine complete throughput model analysis of seabasing sustainment systems. The program will conduct system engineering sensitivity analysis on emerging amphibious ship and seabase concepts to identify key system deficiencies, technological barriers, and technology insertion opportunities; establish a seabasing/MPF focal point for technical analysis support to the Joint Naval Expeditionary Warfare Engineering integrated product team (IPT) for improvement of expeditionary force interoperability with future amphibious (LPD–17), MPFE, and other joint sea/airlift programs; and develop onboard TACLOG (intra-seabase) and combat service support operations center (inter-seabase) C^2 architectures. By FY98, the program will identify and document key technologies for improving seabase operational efficiency and initiate rapid prototyping of identified systems for developmental testing and early user evaluation in FY98–00. In FY01, the goal is to accomplish the transition of (1) mature joint warfighter-ship interface technologies to amphibious/MPF ship platform PMs and (2) technologies for joint amphibious/expeditionary force tactical logistics and C^2 interoperability enhancements to Director C^4I and Program Manager CSS, MARCORSYSCOM.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602131M	C3100	1.2	1.2	1.0	1.2	0	0	0
0603640M	C2223	0	1.2	1.7	2.0	2.5	0	0
	Total	1.2	2.4	2.7	3.2	2.5	0	0

F.18 ***Joint Advanced Health and Usage Monitoring ACTD.*** This ACTD is a joint Navy/Army demonstration to focus on improving in-flight safety and maintenance reliability of helicopters. The participants will coordinate with industry, including the Rotorcraft Industry Technology Association (RITA), in defining common industry health and usage monitoring standards and architectures. The ACTD will evaluate technologies focusing on reducing life-cycle costs, improving system safety and performance, increasing operational availability, and streamlining maintenance and logistics infrastructure in Army and Navy helicopter communities. The effort will evaluate advanced technologies developed by service programs and from commercial industry focusing on monitoring health and usage of specific helicopter components. Presently no military helicopters employ a comprehensive health and usage monitoring system. This ACTD will focus on establishing a baseline of commercial technological competency in health and usage monitoring systems and additionally assess the military utility of advanced health and usage monitoring technologies developed by the government as well as any presented by industry. ACTD initiation is scheduled for the second quarter of FY97 with release of a Broad Agency Announcement requesting proposals and inputs from industry.

The Navy will be the lead service and the user sponsor for this ACTD. System development and planning will occur in FY97. Integration of the system aboard six Navy H–60 and six Army H–47 helicopters will be performed in FY98. System flight test and data collection will occur in FY99 and FY00. JAHUMS will additionally coordinate with the Navy H–53 Early Operational Assessment Program and Lead the Fleet Program and with the OSD Open Architecture Systems Task Force to ensure that the approach and technologies assessed can function within an open systems environment.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603750D	P523	0	6.3	5.4	2.1	0	0	0
0603792N	1889	0.6	0	0	0	0	0	0
0603801A		1.2	0	0	0	0	0	0
0603003A		2.2	0	0	0	0	0	0
	Total S&T	4.0	6.3	5.4	2.1	0	0	0
NRTC^*	RITA	TBD	TBD	TBD	TBD	0	0	0
0603801A*		2.2	0	0	0	0	0	0
	Total	6.1	6.3	5.4	2.1	0	0	0

^National Rotorcraft Technology Center
*Non-S&T funds.
Note: Totals may not add due to rounding.

JOINT COUNTERMINE

JOINT COUNTERMINE

G.01 ***Mine Hunter/Killer ATD.*** This DTO will demonstrate the capability to neutralize individual mines and other unexploded ordnance from a mounted platform at maneuver speeds by integrating advanced mine detection and mine neutralization technologies with automated targeting and fire control mechanisms. This capability increases the operational tempo by avoiding time delays due to mines, and enhances force survivability by avoiding direct and indirect fire kills resulting from minefield delays. This DTO encompasses the neutralization component of the Mine Hunter Killer (MH/K) ATD. Specifically, 98% probability of destruction (P_k) of metallic and nonmetallic mines, both surface-laid and buried, at speeds up to 20 mph and standoff ranges up to 75 m.

Specific demonstrated capabilities to achieve the MH/K neutralization goals include, in FY97, demonstration of multiple explosive neutralization concepts and selection of a baseline with the potential for near 100% P_k of mines. Specific concepts include bursting munitions, advanced propulsion schemes, and directed energy for incorporation into a two-stage process to remove any overburden and then penetrate and destroy the mine. The FY98 goal is to demonstrate that the baseline design for the explosive neutralizer can penetrate soil overburdens and can destroy mines at 98% P_k. In FY99, the DTO will demonstrate that integrated neutralization and detection components with automated targeting and fire control can achieve a delivery accuracy to within 1-m CEP at 30-m standoff and achieve 98% P_k. In FY00, the program will integrate MH/K components onto a surrogate platform and demonstrate the ability to kill mines at up to the ATD goals of 75-m standoff, 20-mph ground speed, and 98% P_k.

Milestones for the MH/K ATD include, in FY97, evaluating concepts for standoff point neutralization of mines; in FY98, completing the design and confirming the performance of baseline neutralizer; in FY99, integrating MH/K components and conducting technical and integration tests; and in FY00, conducting the MH/K ATD using a surrogate platform in operational environments.

Technical barriers include accurate, high-coverage-rate mine detection with real-time sensor processing; logistically efficient explosives that allow point destruction of mines; and real-time automated targeting and fire control with accuracy within 1-m CEP at up to 75-m standoff and ground speeds of 5–20 mph.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603606A	608	0	0	9.1	9.6	0	0	0
0602712A	H24	4.0	5.5	4.8	0	0	0	0
	Total	4.0	5.5	13.9	9.6	0	0	0

G.02 ***Vehicular Mounted Mine Detector ATD***. This DTO will demonstrate the capability to detect surface laid and buried mines and other unexploded ordnance from a vehicle-mounted platform, through development of new sensors and integrating sensor fusion and automatic mine recognition techniques. A robust mine detection capability that relies on mine detection technologies for target acquisition is essential for the success of the Mine Hunter Killer (MH/K) ATD. Specifically, the goals for the Vehicular Mounted Mine Detector (VMMD) are 2–5 mph detection speed, 80–90% probability of detection (P_d), and ≅0.15–0.04 false alarm rate (FAR) per meter of advance.

Specific demonstrated capabilities for the VMMD include the following: in FY97, demonstrating three down-looking ground-penetrating radar variants, two electromagnetic inductive coils (metal detector), and two forward-looking infrared (FLIR) sensors (3–5 and 8–12 micron) to achieve an 80% P_d at 3-mph detection speed; and in FY98, demonstrating selected sensors, sensor fusion, automatic mine recognition and marking capabilities, and full-width arrays linked to tele-operation to achieve 5-mph detection speed, 90% P_d, and 0.04 FAR. Specific demonstrated capabilities to achieve MH/K detection goals include the following: in FY97, investigating forward-looking ground-penetrating radar to achieve greater than 80% P_d at 50-m standoff distances; in FY98, demonstrating a multimode, forward-looking, ground-penetrating radar and FLIR capability to reduce false alarms to less than 0.10 and leverage sensor fusion and automatic targeting development from the VMMD ATD; in FY99, demonstrating optimized, forward-looking, ground-penetrating radar and FLIR sensors combined with sensor fusion and real-time automatic mine recognition algorithms to achieve 98% P_d and 0.04 FAR at standoff distances greater than 50 m and at speeds approaching 20 mph; and in FY00, integrating detection components into the MH/K and demonstrating the ability to detect mines and hand targets off to the killer component at up to the ATD goals of 75-m standoff, 20 mph speed, and 98% P_d. (MH/K funding in G.01)

Milestones for the VMMD ATD include, in FY97, selecting the most promising multiple sensor options; and in FY98, conducting the VMMD ATD with integrated components on a tele-operated platform.

Technical barriers for VMMD include mechanisms to distinguish mines from clutter and requirements to operate in diverse environments, terrains, and soils at maneuver speed.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603606A	608	6.2	3.0	0	0	0	0	0
	Total	6.2	3.0	0	0	0	0	0

G.04 ***Joint Countermine ACTD.*** This DTO will demonstrate selected clandestine reconnaissance and detection technologies and in-stride neutralization and clearance technologies, together with currently fielded capabilities, to improve the task force commander's ability to conduct seamless countermine operations from the sea, through the surf zone, and on land. Specific demonstrated capabilities to achieve the Joint Countermine (JCM) ACTD goals include, in FY97, demonstration of standoff reconnaissance and detection of mines and minefields in the surf zone, on the beach, and on land, using littoral remote sensing, the Airborne Standoff Minefield Detection System (ASTAMIDS), Magic Lantern (Adaptation), the Coastal Battlefield Reconnaissance and Analysis system (COBRA), and the Close-In Man-Portable Mine Detector (CIMMD) to achieve 80% probability of detection (P_d). The ACTD will demonstrate clandestine reconnaissance in shallow water for sea mine detection using advanced sensors (electro-optics) to enhance detection ranges to three times that of a diver; and demonstrate in-stride movement through the surf zone, beach, and land, using standoff neutralization. Specifically, the Explosive Neutralization Technology Demonstration (EN–TD) and Joint Amphibious Mine Countermeasure (JAMC) will provide an in-stride breaching capability from the sea, reducing current clearance time by 50% in sea state 3. Off-route smart mine countermeasures will provide 90% neutralization of off-route land mines at speeds of 20 mph and will demonstrate the ability to disseminate joint countermine data from novel platforms over existing communication assets. In FY98 the goal is to demonstrate an enhanced clandestine reconnaissance capability in shallow water using advanced sensors (torodial volume search sonar) to provide a 1,500-yard standoff and a P_d and P_c (probability of classification) greater than 0.95; and demonstrate neutralization of influence mines in shallow water with the Advanced Lightweight Influence Sweep System (ALISS), using signature management and duplication. FY00 goals include demonstrating area clearance and in-stride detection and neutralization of land mines using the MH/K.

Milestones for the JCM ACTD include, in FY97, demonstrating the ability to conduct joint U.S. Army/Navy/Marine Corps shallow-water-to-land countermine operations using developmental and fielded countermine systems (Demo I); in FY98, demonstrating the ability to conduct seamless operations from deep water, through the beach to land objectives (Demo II); in FY00, demonstrating the ability to conduct surf zone detection and clearance, and conducting post-hostility/logistic tasks while operating in a mined environment (Demo III, proposed); and in FY03, demonstrating advanced technology concepts integrated with previous demonstration residuals (Demo IV, proposed).

Technical barriers include compatibility of service communication systems, mine detection in the surf zone, beach obstacle removal, data dissemination, data compression, and compatibility of service-specific models.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603606A	608	7.6	5.7	2.2	1.4	0	0	0
0603782N	R2226	8.1	10.1	3.9	1.5	0	0	0
0603750D	P523	1.1	3.1	1.2	2.9	0	0	0
	Total	16.8	18.9	7.3	5.8	0	0	0

G.05 ***Rapid Battlefield Mine Reconnaissance.*** This DTO will demonstrate, in an operational environment, capabilities for coastal area reconnaissance (beach, craft landing zone, and inland areas) using advanced sensors in an unmanned aerial vehicle (UAV). The DTO focuses on the airborne detection capabilities of the Coastal Battlefield Reconnaissance and Analysis (COBRA) TD and its participation in the Joint Countermine ACTD. COBRA incorporates advanced multispectral sensors and optics into the Pioneer UAV for daylight countermine reconnaissance operations. The system uses dual advanced multispectral video cameras (adjacent field of view with overlap), forward-looking video, and video downlink; a ground station processor with real-time tracking and map overlay; and near-real-time processing using advanced target recognition algorithms. A capability to detect minefields with a probability of detection (P_d) of 0.8 and a probability of false alarm (P_{fa}) of 0.3 at an altitude of 500–1,000 ft and at airspeeds of 60–100 kn is planned. Enhanced COBRA optics—including a tunable camera, active illuminator, and passive millimeter-wave imaging—are being developed under the Joint Mine Detection Program (6.2).

Specific demonstrated capabilities include, in FY97, demonstrating the operational suitability of COBRA sensors integrated into the Pioneer UAV during OPEVAL (OT-0). Through participation in JCM ACTD I, the program will demonstrate ground station processing for automatic minefield detection and localization; determination of minefield and obstacle location using onboard DGPS and aircraft attitude (pitch, roll, yaw) information; detection of ground and buried mines in representative types of terrain; day operations using passive and multispectral electro-optic sensing technologies; and real-time sensor tracking video downlink with map/image track overlay. In FY98, through participation in JCM ACTD II, enhanced/refined capabilities in all areas from the first phase will be demonstrated, including significant improvements in near-real-time ground station processing. In FY99, the program will demonstrate enhanced sensor systems. COBRA will participate in JCM ACTD I/II in FY97–98 and undergo transition to acquisition in FY99.

Technical barriers include high coverage rate, high image resolution, and near-real-time image processing to support automatic target recognition.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603640M	R2223	2.5	3.1	1.9	0	0	0	0
0602131M		1.4	1.3	1.1	1.0	0	0	0
Total		3.9	4.4	3.0	1.0	0	0	0

G.06 ***Rapid Sea Mine Neutralization.*** This DTO will demonstrate the capability to rapidly identify, target, and destroy mines in deep and shallow water with minimum risk to personnel and equipment. Currently, the only means to positively destroy located mines are dedicated mine countermeasures, remotely operated vehicles, or explosive ordnance disposal (EOD) personnel, all of which greatly impede the tempo of joint countermine operations. This DTO focuses on the in-stride mine clearance capabilities of the Rapid Airborne Mine Clearance System (RAMICS) ATD and its participation in the Joint Countermine ACTD. RAMICS will employ a light detection and ranging (LIDAR)-based targeting system and hypervelocity, supercavitating projectiles fired from a conventional 20-mm gun mounted on a helicopter to rapidly neutralize near-surface moored mines within 20 ft of the sea surface.

In FY97, the program will demonstrate preliminary munition integration of the 20-mm Antimine Projectile (AMP); improved aero-/hydrodynamic performance and ballistic characteristics of AMP; target mine vulnerability and AMP reactive-material payload effectiveness; static (tower) platform testing and demonstration of gun and LIDAR targeting and fire control system components; and integrated system-level computer simulation of RAMICS system performance. These demonstrations will characterize performance and lethality of gun, AMP, and targeting and fire control components. The FY98 goal is to demonstrate system lethality and effectiveness against actual mines. This demonstration will finalize AMP and payload design and complete integrated system design. In FY99, the program will demonstrate operation of the fully integrated RAMICS (LIDAR targeting/fire control, 20-mm gun, and AMP) from a static platform. The FY00 goal is to demonstrate in-flight (airborne platform) operation of the integrated RAMICS system against live mines.

Technical barriers for RAMICS include targeting through the modulating air/water interface, helicopter-safe standoff and aspect from mine detonation, targeting and ballistic accuracy supporting a 30–40-shot burst kill, wake interference effects of trailing projectiles, low-drag supercavitating dynamics, and mine penetration and destruction for all mine types (including mine detonation/deflagration for destruction confirmation).

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	0	3.5	4.0	7.5	0	0	0
	Total	0	3.5	4.0	7.5	0	0	0

G.07 ***Autonomous Shallow-Water Influence Sweeping.*** This DTO will demonstrate the ability to successfully conduct autonomous influence sweeping of magnetic and acoustic influence mines targeted against amphibious assault craft in very shallow waters (as shallow as 10 ft). The DTO focuses on the neutralization capabilities of the Advanced Lightweight Influence Sweep System (ALISS) TD and its participation in the Joint Countermine ACTD. ALISS will use superconducting magnet and plasma-discharge pulse power technology to provide high-speed sweeping capabilities (50 kn compared to 27 kn maximum for current helicopter-towed sweeping equipment). ALISS' lightweight and reduced power requirements (150 kW versus 500 kW for current systems) allow it to be deployed from a variety of platforms (helicopter, ship, landing craft air cushion (LCAC), or remote/autonomously controlled boat). This capability will increase personnel and equipment survivability during amphibious landings.

Demonstrated capabilities include, in FY97, a lightweight magnetic sweeping subsystem consisting of a superconducting coil, cryocooler, and controller, with a sweep width greater than 100 yd in realistic at-sea conditions. In FY98, the program will demonstrate a lightweight, 20-dB modulation, pulse-power acoustic sweeping subsystem (spectrally shaped to specifically emulate the signature of friendly assault craft) operating at greater than 35 kn; and an integrated ALISS (acoustic and magnetic subsystems) installed on a rigid-hull inflatable boat for autonomous influence sweeping of the intended amphibious assault lanes in shallow and very shallow water.

Technical barriers include operation of a superconducting-wire 4 K cryocooler in a high-shock/vibration environment, spectral shaping of acoustic pulse from plasma discharge source, electrode life, and low-drag/high-efficiency operations.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603782N	R2226	7.9	2.5	0	0	0	0	0
	Total	7.9	2.5	0	0	0	0	0

G.08 ***In-Stride Amphibious Breaching.*** This DTO will demonstrate the ability to deploy explosive line charges and arrays to neutralize surf and beach zone mines in support of in-stride amphibious assault operations. The focus of the DTO is to demonstrate within the Explosive Neutralization TD (EN–TD) and the Joint Countermine (JCM) ACTD accurate, safe-standoff placement of explosive arrays and line charges and sufficient explosive effectiveness to confidently render anti-invasion mines inoperative. EN–TD will demonstrate extended deployment of amphibious breaching charges from both an LCAC and an unmanned semiautonomous glider launched from offshore by a cargo aircraft. The combined effect of these technologies will be a significant improvement in in-stride breaching capabilities, reducing current clearance time by 50% while dramatically improving the standoff and survivability of launch platforms and personnel.

In FY97, the program will demonstrate at-sea deployment of multiple reduced weight (58% lighter than M–58) line charges from a landing craft air cushion (LCAC); effectiveness of a 33% larger surf zone distributed planar explosive array; and a new fire control subsystem allowing line charges and surf zone arrays to be fired at 30-second intervals from outside the surf zone in sea states up to Condition 3. In FY98, the program will demonstrate full-scale deployment of the Beach Zone Array using a truck to simulate the dynamics of the Magic Carpet unmanned deployment glider; and an integrated LCAC breaching system (fire control, line charge, and explosive array subsystems) operating as a part of the JCM ACTD II. In FY99, the program will demonstrate the integrated Magic Carpet Beach Zone Clearance System (full-scale Beach Zone Array deployed by a Magic Carpet glider).

Technical barriers include accurate launch of explosive line charges and distributed arrays from an LCAC in unsteady seas and from an unmanned glider, generation of increased explosive effectiveness from reduced-tonnage arrays, and full expansion of explosive arrays.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603782N	R2226	7.9	2.5	0	0	0	0	0
	Total	7.9	2.5	0	0	0	0	0

G.09 ***Advanced Mine Reconnaissance/Minehunting Sensors.*** This DTO will demonstrate clandestine reconnaissance for sea mines in a candidate amphibious operating area prior to overt operations, with the aid of modular acoustic, electro-optic, and electromagnetic mine-detecting sensors employed on stealthy unmanned underwater vehicles (UUVs) for mine search. The DTO focuses on the Advanced Detection Suite TD and its participation in the Joint Countermine (JCM) ACTD. A suite of advanced sensor technologies for compatible, compact, and power-efficient use on UUVs is under development in the 6.2 Mine Countermeasures Program. These include a deep-water toroidal-volume search sonar (TVSS) for hunting volume mines in deep water; a side-looking sonar (SLS) for the detection of volume and bottom mines in shallow water; a synthetic aperture sonar (SAS) for very shallow water operation; a high-sensitivity superconducting magnetic field gradiometer for mine classification and for detection of buried mines; and an underwater laser line scan (LLS) optical sensor for mine identification and associated signal and image processing. Ultimately, these advanced sensors, integrated into UUVs launched from submarines and surface ships, will provide naval forces with an organic minehunting capability.

In FY97, the program will demonstrate, as part of JCM ACTD I, LLS sea mine identification capability (three times the visual range of current systems); and individual state-of-the-art performance characteristics of the SLS, dual-frequency SAS, and cryogenic SQUID magnetic gradiometer prototype sensors. The DTO will also validate environment-tolerant, long-distance detection performance of the TVSS in shallow-water applications. In FY98, the program will verify compatible, concomitant operation of multiple sensors (acoustic, magnetic, and optical), without deleterious mutual interference and with enhanced discrimination through multisensor signal fusion; and demonstrate, as part of JCM ACTD II, the ability of multisensor packages towed by a remotely operated semisubmersible vehicle to perform clandestine high-speed sea mine reconnaissance. FY99 activities will quantify verification of enhanced mine classification/identification versus false detections through the use of multisensor fusion. Transition of matured acoustic/optical sensor technologies to sensors P^3I for the Remote Minehunting System (RMS) program will occur during the same period.

Technical barriers include increased coverage rate (higher speeds/longer detection ranges) of sensors with a lower false alarm rate; high-noise acoustic, magnetic, and electro-optic environment; bottom penetration for buried mine detection/classification; suppression of surface/bottom reverberation; and real-time processing and fusion of large data sets from multiple sensors.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602315N		10.1	4.5	2.0	0	0	0	0
Total		10.1	4.5	2.0	0	0	0	0

G.11 ***Advanced Mine Detection Sensors.*** This DTO will demonstrate advanced mine-detecting sensors for integration in current developmental systems to improve the maneuver commander's and individual soldier's ability to detect land mines from a safe distance with a high rate of accuracy at maneuver speeds. The DTO integrates the output of various sensor technologies, including advanced infrared (IR), forward-looking infrared (FLIR), and side-looking radar (SLR) into a set of algorithms producing a single, ground-based detection system. Specially, the goals of the Advanced Mine Detection Sensor (AMDS) are 98% probability of detection (P_d) for antitank and antipersonnel mines, a false alarm rate of less than 0.2 per meter of forward progress, and the ability to operate in all weather conditions

In FY97, the program will evaluate and integrate FLIR technology into a single system for static testing against antitank and antipersonnel mines with a 98% P_d and a false alarm rate of less than 0.2/m of forward progress. In FY98, the goal is to demonstrate potential payoffs for increased standoff detection in all weather conditions using advanced FLIR and SLR technologies. The FY99 goal is to investigate acoustic and seismic technologies as an additional means of enhancing the performance of the ground-based detection systems. In FY00, the program will demonstrate multisensor ability to detect mines remotely at speeds of 5–20 km/hr; and, in FY01, will integrate these technologies onto a surrogate ground-based platform and conduct advanced mine detection demonstrations.

Technical barriers include algorithms to distinguish mines from clutter; requirements to operate in diverse environments, terrain, and soils at maneuver speed; excessive false alarm rate; and detection of small, nonmetallic mines.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602712A	H24	0	1.8	1.5	1.9	1.8	0	0
	Total	0	1.8	1.5	1.9	1.8	0	0

G.12 ***Lightweight Airborne Multispectral Countermine Detection System.*** This DTO will demonstrate a standoff detection system integrated into the tactical unmanned aerial vehicle (UAV) providing route reconnaissance, point detection, and minefield data to support operational planning and tactical maneuvering on the battlefield. The DTO will focus on exploring new focal plane array (FPA) technologies, multi-/hyperspectral imaging, passive-solarization active sources, and electronic stabilization. The goal is to develop a lightweight sensor payload for the tactical UAV while enhancing the performance over the current Airborne Standoff Minefield Detection (ASMD) system sensor and detection algorithms.

In FY98, the Lightweight Airborne Multispectral Countermine Detection System (LAMIDS) will explore concepts and technology to support a lightweight, airborne standoff mine detection capability for limited area (point) detection, limited corridor route reconnaissance, and detection of nuisance mines. The program will investigate a variety of new component and FPA technologies such as 3–5-μm staring FPA, passive polarization, multi-/hyperspectral imaging, active sources, and electronic stabilization to support a lightweight limited capability. In FY99, the goal is to complete study efforts and initiate critical component development; in FY00, to complete development of sensors, mine detection algorithm, and processor modification; and in FY01, to complete integration on a tactical UAV and conduct a demonstration of the system. The major milestone for LAMIDS is to complete a proposed ATD in FY01.

Technical barriers include weight minimization, detection of small mines and targets, discrimination of clutter from targets, and data compression.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602712A	H24	0	0.8	1.5	1.5	0	0	0
0603606A	608	0	0	3.0	6.0	4.0	0	0
	Total	0	0.8	4.5	7.5	4.0	0	0

ELECTRONIC COMBAT

ELECTRONIC COMBAT

H.02 ***Multispectral Countermeasures ATD.*** This program will develop and test advancements in laser technology, energy transmission, and jamming techniques for an all-laser solution to infrared countermeasures (IRCM), as P^3I to the Advanced Threat IRCM/Common Missile Warning System (ATIRCM/CMWS) program. The major goal is to eliminate non-coherent sources via a tunable multiple-line laser with a fiber-optic (FO) transmission line. These improvements will provide the capability of countering both present and future multicolor imaging focal plane array and non-imaging missile seekers. The laser/FO line, in conjunction with advanced detection and jamming algorithm work, will be live-fire tested using the ATIRCM test-bed. These improvements will demonstrate a sixfold increase in jam-to-signal ratio, a twentyfold reduction in laser jam head volume, a 1.2 kW (50%) decrease in ATIRCM/CMWS prime power consumption, and an overall reduction in system weight of 35 lb. By FY97, the program will evaluate IRCM techniques with competing solid-state laser technologies and evaluate FO cable options. The FY98 goal is to integrate laser, FO coupler, and advanced tracker/jammer algorithms and begin lab testing. By FY99, the DTO will conduct a live-fire cable car test to demonstrate countermeasure capability against advanced imaging IR missiles and other secondary threats, such as antitank guided missiles, to rotary-wing aircraft.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603270A	DK16	3.9	5.0	7.0	0	0	0	0
	Total	3.9	5.0	7.0	0	0	0	0

H.04 ***Miniature Air-Launched Decoy ACTD.*** This DTO will develop and demonstrate an affordable ($30,000 average unit flyaway price) decoy system for air-launched applications in the lethal suppression of enemy air defense (SEAD) mission. The Miniature Air-Launched Decoy (MALD) is an expendable decoy and has a primary military utility in offensive operations against enemy air defense systems by diluting and confusing surface-based and airborne defenses with realistic tactical target characteristics. The MALD concept involves the integration of previously developed advanced, small-engine technology (4-inch-diameter turbojet) into a missile form factor, with an advanced, active electronic payload. Current capability is typified by the Tactical Air-Launched Decoy (TALD)/Improved TALD (ITALD) heavy glide/boosted family of passive/active decoys. Critical to the ACTD's success is the key issue/tradeoff of affordability of the total MALD package versus its target realism in all mission scenarios—i.e., the minimum set of electronic payload complexity (e.g., frequency response, antenna form factors, coherent exciter techniques, amplification technology, etc.) By FY99, MALD flight testing will demonstrate operational effectiveness in a Green Flag environment or equivalent. A secondary capability for demonstration will be a simultaneous self-protection capability for the launching fighter/group of fighters. At the end of the ACTD, 32 MALD systems will remain with the operational user for contingency operations.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602702E	TT-06	3.2	19.2	7.0	0	0	0	0
0603750D	P523	4.0	0.7	0	0	0	0	0
	Total	7.2	19.9	7.0	0	0	0	0

H.05 ***Large-Aircraft Infrared Countermeasures ATD.*** The objective is to design, develop, and demonstrate an advanced laser-based infrared countermeasure (IRCM) capability suitable for self-protection of high-IR-signature, large AF aircraft (e.g. C–17, C–5, C–141). Currently fielded IRCM systems are designed to protect lower signature helicopters and suppressed platforms (noncoherent source/open-loop baseline), while large aircraft are equipped with limited warning capabilities and conventional flare technology for self-protection. The coupling of advanced, higher power laser source technologies (doubled CO_2, advanced solid state, or optically pumped semiconductor) with active aimpoint tracking of inbound threat missiles shows promise of a hundredfold increase in jam-to-signal ratio and a 5:1 reduction in missile engagement times. Such figures are necessary to protect large multiengine aircraft throughout their range of mission profiles from the proliferated IR missile threat. By FY99, the program will conduct captive-carry and live-fire IR missile tests verses a full-up IRCM suite, demonstrating (1) end-to-end IR countermeasure capability from advanced missile warning system (MWS) detection and handoff, with a twofold improvement in threat detection range/demonstration of two-color MWS; (2) tracking of the threat and adaptive pointing control of the CM laser; (3) laser jamming, with sufficient laser power to protect large aircraft IR signatures in the 10–100 times baseline regime (aforementioned suppressed signature helicopters and SOF aircraft); and (4) real-time CM effectiveness assessment/analysis (allowing the large aircraft IRCM system to engage multiple threats/shots). The bottom-line benefit to the warfighter will be increased survivability.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603270F	691X	7.5	6.4	1.9	0.9	0.9	0	0
	Total	7.5	6.4	1.9	0.9	0.9	0	0

H.06 ***Advanced Electronic Countermeasures Transmitter ATD.*** This DTO will develop and demonstrate a broadband shipboard RF, ECM transmitter capable of defending against modern antiship missiles and related threat weapon systems from surveillance/targeting through terminal missile run-in phases of an engagement. A brassboard ECM system producing the required transmit beams over one full quadrant will be designed and demonstrated. Final system configuration will be four per ship. The advanced transmitter will cover the full angular sector of 90 deg and increase the azimuthal coverage by a factor of five over current systems. Transmitted power will exceed that of current shipboard systems by a factor of 2.5. The number of beams per quadrant will be larger by a factor of four. This ATD will demonstrate a brassboard state-of-the-art planar array aperture fed by advanced, solid-state monolithic microwave integrated circuit (MMIC) power amplifiers and a novel photonic beam formation and steering subsystem. These collective improvements add significant ship self-protection capability against multiple missiles/threat weapon systems, particularly in a multishot engagement, in at-sea or littoral mission scenarios. In late FY97 and early FY98, fabrication and integration tasks will be executed. During the last quarter of FY98, a full-up field demonstration will be conducted at a coastal test site. Starting in FY99, the system will be ready for shipboard integration with the electronic support receiver measurement system of the Advanced Integrated EW System.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	5.5	4.0	0	0	0	0	0
	Total	5.5	4.0	0	0	0	0	0

H.07 ***Enhanced Situation Awareness Insertion ATD.*** During mission execution and engagement phases, aircraft survival and successful weapon delivery depend on aircrew situation awareness (SA) based on timely and accurate information. Currently, threat and target information is primarily supported by pre-mission planning intelligence collection and updates are relayed by voice communications. In addition, aircrew situation awareness is limited by onboard sensor ranges, and weapon systems have very limited capability for over-the-horizon targeting and real-time mission updates from offboard information sources. The objective of the Enhanced Situation Awareness Insertion (ESAI) ATD is to design, develop, evaluate, and demonstrate hardware and software approaches and techniques to provide aircrews (tactical, strategic, airlift, space, and special operations) a timely, enhanced threat alert and situation awareness capability. Emphasis is on direct application of previously developed, automated, decision-making algorithms, hosted by commercial off-the-shelf, real-time symmetric multiprocessing (RTSMP) computer open architecture, and integration with onboard sensor/offboard information correlation techniques. By FY97, the program will demonstrate ESAI on a C–130 platform, and by FY98, on an F–16 tactical fighter. The successful ESAI ATD will achieve automated aircrew defensive SA and real-time retargeting; a hundredfold increase in processor throughput via RTSMP; and a net three to four times acceleration of automatic, enroute correlation of all available offboard/onboard aircraft mission information (regarding threat emitter laydown, mission tasking, precision targeting, and platform defensive response/resource management.) This DTO achieves initial real-time information in the cockpit capability.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603270F	2432	4.5	3.2	0.9	0	0	0	0
	Total	4.5	3.2	0.9	0	0	0	0

H.08 ***Onboard Electronic Countermeasures Upgrade ATD.*** A two-tiered requirement exists to increase survivability of friendly aircraft against the radio frequency (RF) guided missile threat: first, to prevent hostile forces from launching RF guided missiles, and second, to effectively counter those missiles that are launched. This ATD focuses primarily on the first option to maximize the defeat of the threat in the earlier detection/acquisition phases of radar engagement prior to targeting and missile launch. ATD metrics to be demonstrated via flight tests are (1) achieving an 80% reduction in threat missile launch opportunities; (2) reducing kill probability, given launch, by 80%; and (3) achieving an overall reduction in active ECM subsystem volume by factor of two to three. To prevent launch, the ATD will develop and demonstrate advanced, affordable monopulse radar angle breaklock techniques. Two approaches are being pursued in parallel throughout the Onboard Electronic Countermeasures Upgrade ATD. First, a specific, high-payoff, single-aircraft, low-effective radiated power (ERP) jamming technique has been identified at the 6.2 level and will proceed with ATD risk reduction. Since this low ERP approach entails risk, a second, less risky approach is being undertaken involving both single- and dual-platform high-ERP techniques. By FY97, a MAJIC risk reduction brassboard will be fabricated and lab tested, followed by a Phase 1 flight test demonstration in FY99 (Monopulse Angle Jamming Integrated Countermeasure). By FY98, DSEAT electronic architectures will be evaluated and analyzed for affordability (Demonstration of Selected Electronic Attack Techniques). By FY99/FY00, DSEAT/MAJIC component down-selections will occur. Fabrication and final-phase flight testing of each will begin by FY01.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603270F	691X	0.7	0.5	0	0	0	0	0
0603270F	431G	0	0.3	3.0	2.4	4.7	6.1	0.8
Total		0.7	0.8	3.0	2.4	4.7	6.1	0.8

H.09 ***Sensor Fusion/Integrated Situation Assessment TD***. This DTO will develop and demonstrate offboard, all-source information correlation (fusion) with onboard multispectral receiver/sensor information and advanced emitter identification algorithms, to yield platform self-defense at long interdiction/strike ranges, enhanced combat identification, and dynamic route replanning/retargeting. By FY97, the program will conduct flight tests of the retrofit subsystem to demonstrate a tenfold improvement in radio frequency emitter geolocation and real-time specific emitter identification (SEI); flight-test demonstrate the sensor-fused accuracy of radar warning cues coupled to active airborne radar processing to achieve emitter location within 0.1% range CEP in 15 s; and demonstrate enhanced intelligence electronic warfare (IEW) asset management and integrated preparation of battlefield tools and techniques. The FY98 goal is to demonstrate multiple-source fusion by using terrain reasoning tools and techniques and moving target indicator automated tracking. By FY99, the program will demonstrate advanced airborne planning algorithms and integrate into the Army's Intelligence Electronic Warfare Common Sensor (IEWCS) multisensor tasking and reporting tools. By FY02, the goal is to demonstrate integrated RF/IR/laser sensor, processing, and countermeasures suite size reductions of up to 50%, with an attendant 200% increase in mean time between failure (MTBF). Achievement of this DTO will result in real-time situation awareness for which there is limited to no operational baseline capability for single/limited-seat tactical platforms (air/ground). This DTO achieves initial real-time information in the cockpit capability and real-time, bidirectional/C^3I mission information (real time out of the cockpit) for joint commander assessments and digital replanning/retargeting.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602270A	A906	2.7	2.9	3.1	3.2	2.9	2.9	0
0602270A	A442	3.0	3.1	3.4	0	0	0	0
0603270A	DK15	0.6	0.6	0.7	2.0	0	0	0
0602270N	RE70W10	1.0	1.1	1.3	1.3	1.2	1.2	0
0603270F	431G	1.5	0.2	0	0	0	0	0
0603270N	U2090	1.2	1.2	1.3	1.2	1.1	1.1	0
	Total	10.0	9.1	9.8	7.7	5.2	5.2	0

CHEMICAL/BIOLOGICAL WARFARE DEFENSE AND PROTECTION

CHEMICAL/BIOLOGICAL WARFARE DEFENSE AND PROTECTION

I.02 ***Biological Early Warning ACTD*** **(Proposed).** The primary objective of this ACTD is to evaluate the military utility of remote early warning for biological warfare attacks against U.S. forces and to develop the operational procedures and doctrine associated with that capability by FY99. An additional objective, by FY99, is to provide the CINCs an interim residual capability to detect and provide automated warning and reporting to promptly alert only those forces that may be exposed to biological warfare agents. The ACTD will leverage advanced biological detection technologies (e.g., ultraviolet (UV) laser particle sizer, immunoassay fiber optic wave guide) from the DoD counterproliferation initiative and technology base community. The ACTD will demonstrate several remote early warning platforms, including artillery delivered remote detectors, man-emplaced detectors, detectors mounted on remotely piloted vehicles, and standoff active laser detectors. All the remote detectors will be connected to a warning and reporting system that enables the CINC to promptly alert forces (less than 15 minutes) who are downwind of biological warfare agents. Extensive simulation will be conducted in parallel to evaluate the operational utility of the remote early warning system for employment during early entry, buildup, defensive, offensive, and consolidation phases. Preliminary modeling of biological warfare (BW) attack against U.S. forces during a proposed buildup phase shows that an early warning system could reduce casualties by up to 95%. By FY97, the DTO will complete detailed design and field tests of component technologies. By FY99, the system will demonstrate in CONUS networked (Joint Warning and Reporting Network) remote early warning systems against point and long-line source BW attacks. Data fusion of remote detectors into a Joint Warning and Reporting Network is the key to providing early warning of potential BW attacks.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603884BP	CP4	0	17.9	37.1	5.0	5.0	0	0
	Total	0	17.9	37.1	5.0	5.0	0	0

I.03 ***Airbase/Port Biological Detection ACTD.*** By FY98, this DTO will develop and demonstrate a biological local warning capability and operational procedures to detect, alarm, warn, dewarn, identify, protect, and decontaminate large areas against a biological warfare (BW) attack on an airbase or port facility. By FY97, the objective is to demonstrate in CONUS a total system, to provide rapid detection (5 min versus 15 min), semiautomated versus manual warning and reporting of a BW attack using radio frequency links, protection (collective protection and commercial oronasal masks), identification (20 min versus 30 min) and sample handling of eight high-threat agents versus four, and large-area decontamination. This ACTD will demonstrate for the first time the capability to detect and protect high-value, fixed-site assets during point and long-line source BW attacks.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603750D	P523	2.8	1.0	2.0	1.0	0	0	0
	Total S&T	2.8	1.0	2.0	1.0	0	0	0
0604384BP*	BJ5	2.8	1.0	2.0	1.0	0	0	0
	Total	5.6	2.0	4.0	2.0	0	0	0

*Non-S&T funds.

I.04 ***Integrated Biodetection ATD.*** This ATD will demonstrate two technologies: one that provides a preexposure warning for a biological attack, and another that provides an order-of-magnitude increased sensitivity to agents while adding a first-time virus identification capability with significantly reduced logistics. These logistical improvements include automated operation, fivefold reduction in size and weight, reduced storage requirements, and reduced consumables. By FY97, a demonstration of a remote biological aerosol warning capability using micro ultraviolet fluorescent laser-based particle counting technology will be completed. This technology will provide preexposure warning of biological agent attacks for protection of personnel and high-value battlespace assets. The FY98 goal is to demonstrate a point biosensor capability that incorporates an automated DNA diagnostic technology to identify biological agents with the highest known degree of reliability and sensitivity. By FY99, products will be demonstrated separately and as an integrated force protection suite in future battle lab warfighting experiments.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603384BP	CB3	5.8	7.1	6.1	0	0	0	0
	Total	5.8	7.1	6.1	0	0	0	0

I.05 ***Chemical Add-On for the Airbase/Port Biological Detection ACTD*** **(Proposed).** By FY98, this ACTD will demonstrate an integrated biological and chemical detection and warning capability at two sites within the designated areas of operation associated with the current Airbase/Port Biological Detection ACTD. The chemical add-on capability will use mature and available technology (passive IR spectrometry and ion trap spectroscopy) to automatically detect and identify chemical threat agents in near-real time (less than 30 seconds). In addition, a Joint Warning and Reporting Network with hardware and software interfaces between three to four different biological and chemical detectors for the automatic generation of NBC 1 and 3 reports will be demonstrated by FY98. This ACTD will also develop the concept of operations and doctrine associated with the add-on capability at fixed-site assets. This chemical add-on ACTD will provide the CINCs a first-time capability to network legacy and emerging biological and chemical detectors and produce automated warnings and reportings for enhanced battlefield visualization and force protection as defined in *Joint Vision 2010*.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603384BP	CP3	0	1.0	0.5	0	0	0	0
0603750D	P523	0	0.5	1.0	0.5	0.5	0	0
	Total S&T	0	1.5	1.5	0.5	0.5	0	0
0604384BP*	BJ5	0.3	0	2.0	0.4	0	0	0
	Total	0.3	1.5	3.5	0.9	0.5	0	0

*Non-S&T funds.

COUNTER WEAPONS OF MASS DESTRUCTION

COUNTER WEAPONS OF MASS DESTRUCTION

J.03 ***Counterproliferation I ACTD.*** This DTO will develop and demonstrate technologies to effectively target and defeat shallow-buried or bermed, above-ground chemical and biological weapon storage and production facilities while minimizing collateral hazards. This technology development is for demonstration in Phases I and II of the Counterproliferation/Counterforce ACTD. Technologies being developed fall into three categories: weapons, sensors, and planning/targeting tools. Phase I (FY96) of this ACTD demonstrated the application of current warhead technology augmented with a programmable, void-sensing/depth-of-burst-sensing hard-target smart fuse. Planning tools for targeting (munitions effectiveness assessment (MEA)) and collateral effects prediction (Hazard Prediction Assessment Capability (HPAC)) also are demonstrated. In Phase II, to be completed in FY98, Phase I technologies will be supplemented by the following technologies. The Advanced Unitary Penetrator will improve the penetration capability of the BLU–109 by a factor of two to three. The Inertial Terrain-Aided Guidance system will provide adverse-weather capability while maintaining precision guided munitions-level CEPs. The Weapon-Borne Sensor will provide the acceleration history of the penetrator to provide target characterization and battle damage assessment (BDA). Unattended ground sensors will provide characterization and location of critical equipment for targeting and BDA. A modified forward-looking infrared (FLIR) sensor will measure plume signatures for BDA. The MEA and HPAC planning tools will be integrated to provide increased utility for targeting and collateral-effects prediction in Phase II, and will also be upgraded to provide more accurate predictions for hardened, buried structures.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603160D	P6539	35.0	7.4	2.2	1.5	0	0	0
0602715H	AH	0.4	0	0	0	0	0	0
0603750D	P523	1.7	1.0	4.4	5.1	0	0	0
	Total S&T	37.1	8.4	6.6	6.6	0	0	0
0605160D*	P6542	2.8	0	0	0	0	0	0
	Total	39.9	8.4	6.6	6.6	0	0	0

*Non-S&T funds.

J.04 ***Counterproliferation/Counterforce II ACTD*** **(Proposed)**. This DTO is the follow-on to J.03, Counterproliferation/Counterforce I ACTD (CP/CF ACTD I). Objectives and milestones are based, in part, on accomplishments to date and anticipated progress in the CP/CF ACTD I effort. All the details found in the current program plan have not been completed pending final coordination with U.S. European Command—the warfighting command customer/partner for both ACTD efforts. The core objective of this DTO is to develop and demonstrate a more robust range of technologies for defeat of a wider range of NBC targets while continuing to enhance control of collateral effects.

The ACTD will be conducted in two parts: Phase III proposals address adverse-weather, precision guidance technologies as well as advanced sensor technologies to support target characterization and battle damage assessment (BDA); Phase IV will address development of alternative payloads, including high-temperature incendiaries and agent defeat warheads, to mitigate chemical and biological agents. (Phases I and II are conducted under Counterproliferation I ACTD). Both phases will continue to enhance the capabilities of the integrated weapons of mass destruction (WMD) planning tools developed during CP ACTD I. The specific WMD targets to be addressed during the CP II ACTD will be based on the supported CINC's priorities within his area of responsibility. CP ACTD Phases I and II provided basic WMD planning tools, a hard-target smart fuse, and an advanced penetration bomb that essentially provided the capability to deliver an effective high-explosive warhead against soft to moderately hard WMD targets from the surface down to approximately 20 ft below the surface. Phase III (FY98–FY00) will provide sensor and weapon technologies to more accurately characterize the WMD target to allow more precise selection of a three-dimensional aimpoint, allow precision delivery of the weapon under adverse weather conditions, and provide more accurate and timely BDA data for restrike decisions. The weapon technology is precision delivery using inertial terrain-aided guidance to provide highly accurate standoff delivery to selected aimpoints under almost all weather conditions. The sensor technologies involve chemical, biological, and electromagnetic unattended ground sensors (UGS) as well as three-dimensional seismic/acoustic UGS for both target characterization and BDA. They also include FLIR pod modifications that more accurately provide hitpoint determination, high/low order and in/out of cavity detonation determination, potential size of cavity, and type of agent expelled data for BDA. A weapon-borne sensor is also envisioned that will provide underground structural data as well as fuze function data. Phase IV (FY00–02) will provide alternative payloads to provide options other than high explosive to functionally defeat WMD chemical and biological material.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603160D	P539	2.0	37.2	42.1	43.3	50.0	50.3	51.4
0603750D	P523	0	0	5.0	8.0	3.0	0	0
	Total	2.0	37.2	47.1	51.3	53.0	50.3	51.4

J.05 ***Wide-Area Tracking System ACTD*** **(Proposed).** Proliferants may use clandestine delivery of nuclear devices or radiological weapons as threats to U.S. forces and facilities. This program will provide U.S. warfighting commands with critical capabilities needed for the detection and defeat of such threats. This effort is in the final stages of development. It is a collaborative program funded by OUSD(A&T), the Defense Special Weapons Agency (DSWA), and the Department of Energy (DOE). DSWA is serving as the demonstration manager for this ACTD.

Under DOE sponsorship, Lawrence Livermore National Laboratory has already developed the critical enabling technologies for this DTO: sensors capable of detecting clandestinely transported nuclear weapons/materials, and the algorithms needed to reliably detect (with low false alarm rates) and track the movement of such threats. Initial priorities in this DTO are to develop and demonstrate fieldable prototypes of these capabilities. This will include work on system engineering design for the initial fielded capability and refinement of a concept of operation for use of this capability by a warfighting organization. The key technical challenge in the field will be to achieve high levels of detection and tracking with low levels of false alarms. Sensor technologies are highly sensitive; there is more background and point-specific radiation in the environment than is sometimes appreciated.

Follow-on phases will refine the fielded capability, and include tests against simulated clandestine threats. The leave-behind capability will be a system for wide-area detection of clandestine nuclear/radiological threats. Depending on what is learned during field trials, this capability may be integrated with the Airbase/Port Bio Detection ACTD product or the DSWA Corral Monitoring System.

As a new capability redressing a major shortfall in current warfighter resources, this effort does not lend itself to quantification of benefits; the baseline is zero. The Joint Staff is involved in the effort as a customer representative. The identity of specific warfighting organization customers is sensitive information.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603711H	CA	0.8	0.6	0.3	0.3	0	0	0
0603750D	P523	0.3	0.3	0.3	0.3	0	0	0
	Total	1.0	0.9	0.6	0.6	0	0	0

Note: Totals may not add due to rounding.

SECTION II

DEFENSE TECHNOLOGY AREA PLAN

DEFENSE TECHNOLOGY OBJECTIVES

AIR PLATFORMS

AIR PLATFORMS

AP.01.00 ***Advanced Aerodynamic Concepts for Increased Flight Efficiency.*** This DTO demonstrates affordable aerodynamic technologies that provide increased cruise efficiency and reduced weight over current fixed-wing aircraft technology, yielding increased range and payload both with and without external weapons.

The overall objectives are to demonstrate, by FY02, a 10% increase in cruise lift/drag, a 25% reduction in nozzle weight, a 35% reduction in inlet/duct weight, contributing to the goal of a 20% reduction in airframe weight; and a 25% reduction in nozzle cost, contributing to a 20% reduction in aircraft production costs and a 20% reduction in operation and support costs.

In FY97, the program will demonstrate performance of compact inlets with minimum boundary layer control for reduced inlet/duct weight. In FY98, it will demonstrate a multipoint tailless fighter configuration with a higher aspect ratio lambda wing to increase cruise lift-to-drag ratio. Powered lift for airlift/patrol/bomber configurations will be demonstrated to increase landing lift coefficient and reduce takeoff distance in FY99. In FY00 the program will demonstrate a low drag LO weapons pod at transonic and supersonic speeds to minimize the effect of external weapons carriage on cruise efficiency. A reduced weight, structurally integrated fixed area thrust vectoring nozzle for cruise-efficient fighter/attack aircraft will be demonstrated in FY01. In FY02, the program will demonstrate reduced weight and volume of a high-performance, full-scale compact, fixed-geometry inlet for cruise efficient fighter/attack aircraft. Demonstration of these technology advancements will contribute to a 25% increase in range/payload and a 10% reduction in takeoff gross weight.

Technology barriers to overcome for increased cruise efficiency are the weight of the higher aspect ratio wings, controlling and minimizing localized separated flow, and integrating a high-lift system into a thin wing. Barriers to achieving low aircraft drag while carrying external weapons in a low-drag weapons pod are weight, acoustic, and store separation environments. Barriers to achieving a reduced weight thrust vectoring nozzle with full area control include response rates, controllability, airflow requirements, and load sharing with cold airframe structure. Barriers to achieving lightweight compact inlets include reducing duct length with minimal total pressure loss, acceptable boundary layer control while maintaining stability and total pressure recovery, and maintaining high performance above Mach 1.5.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602201F	2404	5.5	4.8	5.5	6.2	5.0	0	0
0603245F	2568	1.4	1.9	2.8	0.9	1.4	0	0
0602122N		1.0	1.3	0.8	1.2	1.3	0	0
Total		7.9	8.0	9.1	8.3	7.7	0	0

AP.02.00 ***Fixed-Wing Vehicle Structures Technology.*** This DTO addresses a subset of the fixed-wing vehicle subarea goals: production cost, EMD cost, and airframe weight. This DTO demonstrates structural performance improvements resulting from reduced weight and cost, leading to a 30% reduction in manufacturing cost for fighter/attack airframe and a 20% fighter weight reduction by FY00.

Specific technology objectives include, in FY97, a ground test of a conformal load-bearing antenna structure for 50% lower installation cost and 50% less weight; in FY00, a composite primary structural demonstration for a 30% structural weight reduction and 20% reduced fabrication costs; in FY02, a manned flight demonstration of active aeroelastic wing, for a 10% structural weight reduction; and in FY08, a demonstration of virtual prototyping for a 50% reduction in development time. These technologies will directly contribute to attainment of system payoffs of 10% in reduced life-cycle cost, a 25% increase in mission range or payload, a 15% reduction in susceptibility and a 10% reduction in takeoff gross weight.

Existing development times and costs are too high because of the need for extensive sub-element design and hardware testing. Virtual prototyping and interdisciplinary design and analysis are required to significantly cut the time and cost to reach EMD. Current analytical codes are unable to predict structural responses to twin-tail buffet and weapon bay acoustic excitation. The application of higher percentages of composites in future flight vehicles is critically dependent upon reducing the cost of design, layup, manufacturing, and assembly of advanced composites. Active aeroelastic wings require the synthesis of three-dimensional structural properties, modified aerodynamic properties, and modified control systems for improved maneuverability. Conformal antennas to reduce drag and improve radar and communication performance require the combination of load-bearing structures with the antenna electromagnetic characteristics.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602201F	2401	7.7	8.7	10.1	9.5	11.3	13.6	15.0
0603211F	486U	5.4	6.6	7.7	5.1	2.4	5.2	3.4
0602212N		0.5	1.2	1.0	1.3	1.0	1.0	1.0
	Total	13.6	16.4	18.8	15.9	14.7	19.7	19.4

Note: Totals may not add due to rounding.

AP.03.00 ***Aircraft Support/Sustainment Reduction.*** This DTO will develop, demonstrate, and transition technologies to extend the lives or reduce the costs of aging aircraft. The four technology areas are corrosion/fatigue, widespread fatigue damage (WFD), repairs, and dynamics. Corrosion/fatigue and WFD advances will improve the life assessment of aircraft structures with multisite damage (MSD) and corrosion present. Metrics and transformations accounting for corrosion and MSD will be developed and demonstrated and transitioned to the air logistics centers (ALCs). Probabilistic analysis will be the primary focus of these efforts, due to the numerous parameters involved. Applications of damage-tolerant bonded repairs will be developed and demonstrated. A design tool for use by ALC engineers to quickly and confidently design patch repairs will be transitioned to operational use. Improved prediction and control of damaging dynamic loads will increase fatigue life and reduce support costs. The ability to predict the effects of unsteady aerodynamic loads will be developed and used with advanced structural concepts to increase fatigue life and reduce the support cost of aircraft.

The results of these technology advances will provide a 20% increase in fatigue life and a 20% reduction in support costs during Phase 1 (FY00); a 30% increase in fatigue life and a 30% reduction in support costs in Phase 2 (FY05); and a 40% increase in fatigue life and a 40% reduction in support costs in Phase 3 (FY10). Specific technology demonstrations include, in FY98, a preferred spare for a high-performance-aircraft wing spar; in FY00, life assessment, including corrosion effects; in FY02, life assessment, including WFD effects; in FY03, validated, bonded repair design tool; and, in FY06, validated airframe system life enhancement techniques. These results will constitute a significant part of the system-level payoffs of 10% reduction in operations and support costs and 10% increase in operational readiness.

There is currently no means for predicting the response of aircraft structures to degradation due to corrosion, multisite damage, or unsteady aerodynamics. The highly complex nature of corrosion chemistry and the random nature of fatigue cracks are further complicated by a shortfall in nondestructive inspection techniques to detect these forms of damage. Codes to model the aerodynamic characteristics of the aircraft are unable to predict structural response.

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0602201F	2401	8.0	8.0	7.9	9.0	7.6	5.5	4.6
0603211F	486U	3.7	6.2	6.6	11.5	13.1	11.8	14.2
	Total	11.7	14.2	14.5	20.5	20.8	17.3	18.8

Note: Totals may not add due to rounding.

AP.04.00 ***Flight Control Technology for Affordable Global Reach/Power***. This DTO develops flight control technologies leading to affordable aircraft control systems that automatically adjust to and survive combat damage; have on-board systems to identify flight control component failures to reduce repair time; provide supersonic tailless fighter control to improve range/payload; have power-by-wire/fly-by-light control technology to improve reliability; have LO air data systems to improve survivability; and operate in poor visibility with an autonomous landing system to increase operational readiness. The program will develop the following technologies: 15 horsepower electric actuation; LO air data system yielding 25% reduced life-cycle cost; photonic vehicle management systems with 20 times faster throughput; battle-damaged tolerant/reconfigurable flight control systems; lower observable aerodynamic controls effectors; and weather-piercing visual flight system for 75% lower decision height. FY97 activities will produce an autonomous landing guidance flight demonstration, an innovative control effector wind tunnel test, and a fighter aileron electric actuator flight demonstration. In FY98, the program will undertake a fly-by-light component flight test. In FY99, laboratory demonstration of optical air data components will be completed. FY00 activities will produce a reconfigurable control tailless aircraft simulation demonstration, and, in FY01, the program will flight demonstrate a fighter high-horsepower stabilator electric actuator.

Development of this technology will, by FY02, contribute to the reduction of fighter/attack aircraft operation and support costs by 20%, increase range by 25%, reduce radar signature, and improve lethality. For large aircraft, the program will, by FY02, contribute to total elimination of aircraft hydraulics, enable landing without ground-based navigation aids into Cat III conditions, and contribute to a 20% increase in range or payload.

Technology barriers include the inability to generate directional aerodynamic control power for tailless aircraft; identify on-line aerodynamic model and control law changes needed to compensate for battle-damaged or failed control surfaces; package high-horsepower electric actuation within aircraft mold lines; field affordable, low-observable air data systems for highly dynamic flight vehicles; and field reliable photonic connectors, backplane, and electro-optic conversion components for fly-by-light.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602201F	2403	8.6	11.9	11.1	11.5	11.7	12.0	12.4
0603205F	2978	0.3	1.8	2.2	2.6	2.6	1.6	0.5
0603245F	2568	0	0	1.1	1.1	2.1	2.4	4.6
0602122N		0.8	1.5	1.6	1.5	1.6	1.7	1.7
	Total	9.7	15.2	16.0	16.7	18.0	17.7	19.2

AP.05.00 ***Maturity Demonstration of Advanced Air Platform Technologies.*** This DTO validates advanced technologies in a realistic operational environment. The F–15 MANX thrust-vectored tailless aircraft will integrate flight and propulsion control. Fly-by-light (FBL) technology for fighter aircraft using commercial off-the-shelf (COTS) will demonstrate fiber optics as the flight control signal carrier. Reconfigurable control for tailless aircraft (RCTA) will demonstrate real-time parameter identification and control law design. Advanced aeroelastic wing (AAW) will demonstrate integration of flexible structures and flight control. These technologies will be demonstrated on the Future Aircraft Technology Enhancement (FATE) vehicle.

Specific activities include a MANX flight test in FY98, a FBL COTS flight test in FY99, an AAW flight test FY99, and an RCTA flight test in FY01. The FATE vehicle (an uninhabited scaled technology demonstration) will be flight tested from FY01 through FY03. Based on contractor studies, MANX is predicted to produce a 13% improvement in range and a 15–20% reduction in peacetime loss rate due to spin prevention and departure recovery. Reduced support cost, signature reduction, and increased agility are still being assessed. FBL COTS will reduce life-cycle cost. RCTA is projected to reduce flight control development cost by 10%. AAW has a projected savings of 10% of the wing weight of the flight test vehicle. The predicted new aircraft design weight savings for a subsonic fighter is 10%, and 20% for a supersonic fighter. AAW will enable weight-competitive higher aspect ratio wings and smaller control surface deflection ($\cong$5 deg maximum). FATE is projected to save 50% in production cost for an all-composite airframe and 20% on life-cycle cost, increase cruise lift/drag 20%, and reduce weight by 20%. Technologies integrated in this program will contribute to a 10% reduction in system life-cycle cost, a 25% increase in range or payload, and a 10% reduction in takeoff gross weight.

MANX technology barriers include integrating flight and propulsion control, developing sufficient control power at supersonic speeds, and reliability with failure mode accommodation. The FBL COTS challenge is to maintain flight safety and reliability requirements. RCTA is tackling real-time parameter identification and control law design. The integration of flight control and structural strength technology is the challenge to AAW. The FATE technology barrier is the integration of technologies to produce cost and performance benefits greater than the sum of the individual technologies.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602201F	2404	0.7	0.7	0.6	0	0	0	0
0603205F	2978	0	0	0.6	2.1	2.4	3.3	5.3
0603211F	486U	0.8	2.2	3.4	0	0	0	0
0603245F	2568	1.2	2.1	2.2	2.1	2.9	0.9	2.4
	Total	2.7	5.0	6.8	4.2	5.3	4.2	7.7

AP.06.00 ***Helicopter Active Control Technology.*** This DTO will demonstrate rotary-wing flight control technologies leading to, by FY02, a 50% reduction in the probability of encountering degraded handling qualities due to flight control system failures; a 60% improvement in weapons pointing accuracy; a 10% increase in agility and maneuverability; and a 30% reduction in flight control system flight test time compared to current technology through simulation and flight test of second-generation digital fly-by-light control systems, integrated fire/fuel/flight control, robust control law design methods, and fault tolerant architectures. The FY99 goal is to complete hardware and software preliminary design. By FY00, the program will fabricate hardware and conduct software V&V. By FY02, the program will install the system and conduct ground and flight tests.

The HACT DTO will demonstrate capability improvements to all-weather/night mission performance, flight safety, and development time/cost that contribute to a 4% reduction in RDT&E costs, a 30% increase in maneuverability/agility, and a 30% reduction in major accident rate. These improvements will contribute to system-level payoffs in reducing development and operation and support costs.

The program will integrate state-of-the-art rotorcraft flight control technologies and exploit developments in fixed-wing hardware components and architecture to overcome barriers such as the lack of knowledge of optimal rotorcraft response types; techniques for sensing the onset of limits and cueing the pilot; inadequate air vehicle math modeling and flight control system design, optimization, and validation techniques; and lack of knowledge in the optimum functional integration of flight control, weapon systems, and pilot interface.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603003A	D313	0	0.5	3.2	10.0	9.0	6.3	0
	Total	0	0.5	3.2	10.0	9.0	6.3	0

AP.07.00 ***Demonstration of Advanced Rotor Concepts.*** This DTO will demonstrate aeromechanics technologies leading to, by FY04, an increase in maximum blade loading of 25%, an increase in rotor aerodynamic efficiency of 10%, a reduction in aircraft loads and vibration loads of 53%, and a reduction in acoustic radiation of 7 dB over current technology via advanced concept evaluation and application in enabling technology and applied technology efforts. By FY98, model-scale, active on-blade active control rotor concepts will be demonstrated for reducing vibration and noise. By FY00, concepts toward the elimination of conventional rotor lag dampers through the application of smart structures and rotorcraft analysis methodology improvements will be demonstrated. By FY02, the program will fabricate an advanced active control rotor for wind tunnel testing.

These demonstrations contribute to rotary-wing vehicle system level payoffs for FY05 of a 136% increase in range or 98% increase in payload, a 15% increase in cruise speed, a 50% increase in maneuverability/agility, a 45% increase in reliability, and a 10% reduction in operation and support costs for fielded and new systems. Achieving these objectives will be accomplished by executing a set of programs and demonstrations to substantially increase the prediction effectiveness of rotorcraft analysis methodology and to overcome barriers such as the accurate prediction and control of stall, drag, and compressibility characteristics; actuators constructed using smart materials for primary control and vibration control; and understanding and modeling the effects of critical airwakes on the dynamics of rotorcraft.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602211A	A47A	3.2	3.4	3.5	3.4	0	0	0
0603003A	D313	0	0	0	0	3.0	9.5	22.9
	Total	3.2	3.4	3.5	3.4	3.0	9.5	22.9

AP.08.00 ***Fighter/Attack/Strike Propulsion.*** Technology demonstrations for the Integrated High-Performance Turbine Engine Technology Program are divided into the three fundamental classes of gas turbine engines: man-rated turbofan/turbojet engines for fighter/attack/strike applications; man-rated turboshaft/turboprop engines for transport/patrol/helicopter applications; and expendable engines for cruise missile applications. For fighter/attack/strike propulsion, the goals are to demonstrate, by FY97, a 60% increase in thrust/weight ratio, a 200°F increase in combustor inlet temperature, and a 20% decrease in acquisition and maintenance costs from the 1987 state of the art, via core demonstrations in the Advanced Turbine Engine Gas Generator effort and full engine demonstrations in the Joint Technology Demonstrator Engine effort. By FY03, the program will demonstrate a 100% increase in thrust/weight ratio, a 400°F increase in combustor inlet temperature, and a 35% reduction in acquisition and maintenance costs.

Payoffs for achieving the fighter/attack/strike goals include increased aircraft payload by 50%, increased mission radius by 115%, or reduced takeoff weight for new aircraft by 35%. All of these payoffs lead to improved aircraft affordability (system capability/system cost)—the first two via enhanced capability and the latter through reduced cost.

The technology barriers for doubling propulsion system capability are well known. Higher temperatures at combustion initiation are required to decrease fuel consumption (via increased compression system pressure ratio) or increase maximum flight speed, thereby expanding the flight envelope; higher maximum temperatures are required to increase the output per unit airflow (specific thrust); less weight per unit airflow is required to increase the output per unit weight (thrust/weight or power/weight ratio); and all of the preceding advances must be accomplished while maintaining or increasing component efficiencies, durability, and life and while reducing cost. Specific technology development areas include application of advanced materials that exhibit higher temperature capability and lower density; improved aerothermodynamic design capability for improved component efficiencies and control of heat transfer; innovative structural concepts for part count reduction and improved durability; and compatibility of these developments with lower cost manufacturing processes.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602203F	3066	32.6	34.9	35.5	36.8	37.4	38.8	39.9
0603202F	668A	23.2	25.6	26.5	27.4	28.6	29.0	30.0
0603216F	681B	28.3	31.0	32.2	33.3	35.0	35.1	36.0
0602122N		4.5	5.2	6.1	6.1	6.1	6.1	6.1
0603217N	W2014	5.7	6.4	4.7	3.0	3.1	3.3	3.5
	Total	94.3	103.0	105.0	106.6	110.2	112.3	115.5

Note: Totals may not add due to rounding.

AP.09.00 ***Transport/Patrol/Helicopter Propulsion.*** Technology demonstrations for the Integrated High-Performance Turbine Engine Technology Program are divided into the three fundamental classes of gas turbine engines: man-rated turbofan/turbojet engines for fighter/attack/strike applications; man-rated turboshaft/turboprop engines for transport/patrol/helicopter applications; and expendable engines for cruise missile applications. For transport/patrol/helicopter propulsion, the goals are to demonstrate, by FY97, a 30% reduction in specific fuel consumption, an 80% increase in power/weight ratio, and a 20% decrease in acquisition and maintenance costs from the 1987 state of the art via demonstrations in the Joint Turbine Advanced Gas Generator effort. By FY03, the program will demonstrate a 40% reduction in specific fuel consumption, a 120% increase in power/weight ratio, and a 35% decrease in acquisition and maintenance costs.

Payoffs for achieving the transport/patrol/helicopter goals include a 200% increase in time-on-station for patrol/surveillance aircraft; payload increased by over 33% and fuel consumption reduced by over 50% for equivalent CH–47D mission; or mission radius increased by 40% with double personnel payload for UH–60L helicopter. All of these payoffs lead to improved aircraft affordability (system capability/system cost).

The technology barriers for doubling propulsion system capability are well known. Higher temperatures at combustion initiation are required to decrease fuel consumption (via increased compression system pressure ratio) or increase maximum flight speed thereby expanding the flight envelope; higher maximum temperatures are required to increase the output per unit airflow (specific thrust); less weight per unit airflow is required to increase the output per unit weight (thrust/weight or power/weight ratio); and all of the preceding advances must be accomplished while maintaining or increasing component efficiencies, durability, and life and while reducing cost. Specific technology development areas include advanced materials that exhibit higher temperature capability and lower density; improved aerothermodynamic design capability for improved component efficiencies and control of heat transfer; innovative structural concepts for part count reduction and improved durability; and compatibility of these developments with lower cost manufacturing processes. Other technology barriers include control of cooling air in small blades and vanes, centrifugal impeller aerodynamics, and operation at higher rotor speeds.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602203F	3066	2.3	2.4	2.4	2.4	2.5	2.6	2.7
0603216F	681B	1.6	0.7	2.0	2.0	2.0	2.0	2.0
0602122N		0.7	0.9	1.0	1.0	1.0	1.0	1.0
0603217N	W2014	0.7	0.6	2.0	2.9	2.9	2.9	2.9
0602211A	A47A/ A47B	2.2	2.2	2.3	2.3	2.5	2.5	2.5
0603003A	D447	7.8	6.6	6.6	7.2	7.1	7.0	7.1
	Total	15.3	13.4	16.3	17.8	17.9	18.0	18.2

Note: Totals may not add due to rounding.

AP.10.00 ***Cruise Missile/Expendable Propulsion.*** Technology demonstrations for the Integrated High-Performance Turbine Engine Technology Program are divided into the three fundamental classes of gas turbine engines: man-rated turbofan/turbojet engines for fighter/attack/strike applications; man-rated turboshaft/turboprop engines for transport/patrol/helicopter applications; and expendable engines for cruise missile applications. For cruise missile/expendable propulsion, the goals are to demonstrate, by FY97, a 70% increase in thrust/airflow, a 30% reduction in specific fuel consumption, and a 45% acquisition cost reduction from the 1987 state of the art, via demonstrations in the Joint Expendable Turbine Engine Concept effort. By FY03, the program will demonstrate a 40% reduction in specific fuel consumption, a 100% increase in thrust per unit airflow, and a 60% reduction in cost.

Payoffs for achieving the cruise missile/expendable propulsion goals include supersonic cruise missiles with a 200% range increase over a rocket, a 30% payload increase enabling an intercontinental range ALCM-sized missile, and over 100% increase in loiter time for unmanned air vehicles (UAVs). All of these payoffs lead to improved aircraft affordability (system capability/system cost).

The technology barriers for doubling propulsion system capability are well known. Higher temperatures at combustion initiation are required to decrease fuel consumption (via increased compression system pressure ratio) or increase maximum flight speed thereby expanding the flight envelope; higher maximum temperatures are required to increase the output per unit airflow (specific thrust); less weight per unit airflow is required to increase the output per unit weight (thrust/weight or power/weight ratio); and all of the preceding advances must be accomplished while maintaining or increasing component efficiencies, durability, and life and while reducing cost. Specific technology development areas include application of advanced materials that exhibit higher temperature capability and lower density; improved aerothermodynamic design capability for improved component efficiencies and control of heat transfer; innovative structural concepts for part count reduction and improved durability; and compatibility of these developments with lower cost manufacturing processes. Technologies unique to expendable propulsion include limited life design criteria, long shelf-life requirements without maintenance, and instrumentation of extremely small components.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602203F	3066	3.1	3.3	3.5	3.6	3.6	3.7	3.8
0603202F	668A	3.8	5.0	5.0	5.0	5.0	5.0	5.0
0602122N		0.3	0.4	0.5	0.5	0.5	0.5	0.5
0603217N	W2014	0.7	0.6	1.0	2.0	2.0	2.0	2.0
	Total	8.0	9.3	9.9	11.1	11.0	11.2	11.3

Note: Totals may not add due to rounding.

AP.11.00 ***Aircraft Power (MEA).*** By FY98, under the More Electric Aircraft (MEA) initiative, this DTO will demonstrate the ability to eliminate the need for a central hydraulic system through electric power, demonstrating a tenfold increase in aircraft electrical system reliability and a 100% increase in power system fault tolerance. By FY05, the program will demonstrate a twofold increase in integrated power unit densities, environmentally safe 28-Vdc batteries, high-power density 270-Vdc batteries (less than 1 kW/kg), no airframe-mounted gearbox, a twentyfold increase in power system reliability, and a 200% increase in power system fault tolerance for electric flight control and brake actuation systems.

Aircraft and system-level payoffs for the power technology improvements demonstrated in this DTO include a 20% reduction in deployment requirements for combat aircraft due to reduced ground support equipment; a 15% reduction in maintenance manpower; two-level maintenance instead of three-level; a 15% increase in sortie generation rate; an 8–9% reduction in combat aircraft life-cycle cost, and an 8% reduction in takeoff ground weight for a Joint Strike Fighter-type platform; a fourfold increase in power system reliability for an F–16 platform; and a 15% reduction in vulnerability for combat aircraft.

Major MEA challenges come from both technology and programmatic hurdles. Technical barriers are addressed by four technical efforts: power generation (generator high-temperature, high-strength magnetic materials, electronics life and high-temperature tolerance, cooling, rugged design, turbo-electric machinery integration, power unit rotor dynamics); power distribution (thermal management and passive cooling techniques, fault sensing/switching/reconfigure times, solid-state device leakage currents and "on"-resistance, high-quality silicon carbide material, diode operation temperatures and speed, capacitor scaleability); energy storage (lightweight materials in batteries, charge control under uncontrolled temperatures, high-energy cathode materials, low-temperature operation and lithium anode rechargeability); and systems integration (current/voltage tolerances, minimizing electromagnetic interference, minimum weight/volume redundancy, optimize thermal management, system integration to meet form/fit/function and power density for user, system-level implications of high-power use). The main programmatic challenge is to identify and actively pursue the best retrofit and life-cycle cost improvement opportunities within budgetary constraints.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602203F	3145	14.2	15.1	14.9	15.0	16.3	16.6	17.1
0603216F	3035	2.6	3.7	3.5	3.9	4.1	4.3	4.5
0602122N		0.7	1.0	1.0	1.3	1.4	1.2	1.2
	Total	17.5	19.8	19.4	20.3	21.8	22.1	22.8

Note: Totals may not add due to rounding.

AP.12.00 ***Rotorcraft Drive.*** By FY00, this DTO will demonstrate a 25% increase in power-to-weight and a 10-dB reduction in drive-system-generated noise. Along with these goals, the demonstration will validate the application of advanced materials and a design methodology that will double the mean time between removal (MTBR) of the drive system.

Rotorcraft drive systems payoffs resulting from this DTO include a 15% increase in range or a 25% payload increase for an AH–64 antiarmor mission, as well as a 50% reduction in drive system maintenance man-hour per flight hour and an 8–10% reduction in total aircraft operating cost per flight hour. Drive system source noise reduction translates directly into increased crew/pilot endurance and efficiency in the short term, and reduced hearing loss in the long term.

Technical barriers associated with achievement of the weight and noise goals and the doubling of MTBR involve (1) developing very compact, durable high-reduction ratio gear configurations with over 99.5% efficiency (minimal relative surface sliding) and extremely low vibration and noise characteristics (low kinematic error); (2) maintaining drive system component durability while utilizing a reduced weight/volume high-temperature lubrication system; (3) the application of advanced steel alloys and coatings with high-temperature fracture toughness, bending fatigue strength, and surface durability of gears and bearings; (4) the application of lightweight, affordable, corrosion-resistant housing materials that maintain strength at elevated temperatures; and (5) developing lightweight, low-speed/high-load capacity bearings with extreme durability while operating in a poor lubrication environment.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602211A	A47A/ A47B	0.4	0.5	0.5	0.5	0	0	0
0603003A	D313	2.0	4.0	9.0	7.0	0	0	0
	Total	2.4	4.5	9.5	7.5	0	0	0

AP.13.00 ***Affordable/Supportable Fixed-Wing Vehicle Subsystems Technology.*** This DTO will develop technologies that decrease aircraft weight, increase mission range, and enhance survivability and safety. Reduced manufacturing cost and O&S costs and improved reliability, maintainability, and supportability are an integral part of this DTO. Advanced manufacturing technologies are focused on reducing parts count and simplifying production processes. Low-pressure injection molding of aircraft components, such as windshields, canopies, radomes, and sensor windows, will reduce manufacturing costs up to 50% and parts counts up to 90%. Advanced modeling and simulation will reduce design cycle times up to 25% by developing a system-based tradeoff capability of vehicle components, subsystems, and stores. Application of advanced materials and heat transfer processes, such as electrohydrodynamic heat transfer, will reduce component weight and volume up to 10%. Application of advanced materials to landing gear systems will reduce landing gear weight up to 25% and reduce support costs up to 40%. Attainment of these technology objectives will contribute to the following fixed-wing vehicle (FWV) subarea goals; a 20% reduction in production at T–1; a 20% reduction in operating and support costs; a 20% reduction in engineering manufacturing development cost; and a 20% reduction in airframe weight. In FY97, the program will provide a ground demonstration of lightweight, corrosion-resistant TMC landing gear components. FY98 activities will result in the final ground demonstration of long-life tires for fighters, and flight demonstration of an advanced-computed-air-release-point algorithm to increase payload delivery accuracy. In FY99, the program will produce a flight demonstration of an injection-molded frameless windshield. FY00 activities will develop a FWV subsystems virtual engineering methodology. In FY01, the program will demonstrate a cargo trajectory simulation model to increase payload delivery accuracy. These technologies will contribute to a fighter/attack system range increase of 25%, 10% decrease in life-cycle costs, reduced susceptibility, and 10% increase in operational readiness. Similar payoffs will result for large aircraft.

Technology barriers include control of the low-pressure injection molding process applied to large transparencies; developing advanced tire compounds and designs for small, highly loaded fighter aircraft tires; manufacturing large/complex TMC components; and developing mathematical models of complex physical processes for realistic modeling and simulation.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603211F	2402	0	0.2	0.2	0	0	0	0
0602201F	2402	3.8	5.6	6.7	5.6	3.7	3.8	3.9
0603205F	2978	4.8	1.9	0.6	0	0.3	0.7	0.2
	Total	8.6	7.7	7.5	5.6	4.0	4.5	4.1

AP.14.00 ***Rotary-Wing Structures Technology.*** This DTO will demonstrate structures technologies leading to, by FY01, a 15% increase in structural efficiency, improve structural loads prediction accuracy to 75%, and reduce costs by 25% without adversely impacting airframe signature, through both enabling technology and applied technology efforts. By FY98, the program will develop and demonstrate manufacturing process feedback algorithms to actively control the cure state of composite resins. By FY00, it will demonstrate adaptive, out-of-autoclave tooling with preferential heating to optimize the cure cycle of co-cured composite elements of highly variable thickness. By FY01, the program will demonstrate airframe sections tailored for structural efficiency, producibility, and field supportability.

These demonstrations contribute to rotary-wing vehicle system level payoffs of a 55% increase in range or a 36% increase in payload, a 20% increase in reliability, a 10% improvement in maintainability, a 6% reduction in RDT&E costs, a 15% reduction in procurement costs, and a 5% reduction in operation and support costs over current technology.

These objectives will be achieved by executing a set of programs and demonstrations to overcome barriers such as nonintrusive monitoring components and techniques, and sensors, algorithms, and methods to improve design and manufacturing processes.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602211A	A47A	0.3	0.4	0.4	0.4	0.5	0	0
0603003A	D313	0.8	1.5	4.8	6.3	5.5	0	0
	Total	1.1	1.9	5.3	6.8	6.0	0	0

Note: Totals may not add due to rounding.

AP.15.00 ***Rotary-Wing Affordable/Supportable Subsystems Technologies.*** This DTO will demonstrate subsystems technologies leading to, by FY04, a 45% reduction in maintenance costs per flight hour per installed shaft horsepower over current technology via advanced concept evaluation and application in both enabling technology and applied technology efforts. By FY98, the program will demonstrate seeded fault validation testing. By FY00, the goal is to demonstrate dynamic component fault detectors and virtual maintenance tools. By FY02, the program will conduct aircraft modifications for advanced diagnostics and prognostics for on-board systems integration on an operational helicopter.

These demonstrations contribute to rotary-wing vehicle system level payoffs of a 20% improvement in maintainability, a 45% increase in reliability, and a 10% reduction in operation and support costs over current technology (FY05). These objectives will be achieved by executing a set of programs and demonstrations to overcome barriers such as non-intrusive monitoring components and techniques, and sensors, algorithms, and methods to permit real-time monitoring of flight loads and damage.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602211A	A47A	0.6	0.7	0.7	0.7	0	0	0
0603003A	D313	0	0	0	1.0	3.5	6.0	5.5
	Total	0.6	0.7	0.7	0.7	3.5	6.0	5.5

AP.16.00 ***Rotary-Wing Signature Reduction Technologies.*** This DTO will demonstrate subsystems technologies leading to, by FY05, a 40% reduction in radar cross section signature, a 50% reduction in infrared signature, and a 55% reduction in the visual/electro-optical signature over current technology, via evaluation and application of new concepts in both enabling technology and applied technology efforts. By FY99, the program will develop multispectral airframe coatings compatible with radar absorbing materials/structures and low-cost, lightweight thermal insulative materials. By FY00, it will demonstrate full-scale engine exhaust suppression concepts. By FY02, the program will develop selected state-of-the-art active/passive countermeasures and aircrew situational awareness concepts.

These demonstrations contribute to a rotary-wing vehicle TDA system level payoff of a 60% increase in probability of survival over current technology. These objectives will be achieved by executing a set of programs and demonstrations to overcome barriers such as the integration of both active and passive countermeasures to produce a mission-effective, survivable rotary-wing vehicle that is both supportable and affordable.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Mr. Bill King ONR Code 351 (703) 696-4109		

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602211A	A47A	0.9	1.1	1.4	0.8	0.8	0	0
0603003A	D313	0	0	0	0	0	1.7	5.3
	Total	0.9	1.1	1.4	0.8	0.8	1.7	5.3

AP.17.00 ***Hydrocarbon Scramjet Missile Propulsion.*** The goal of this program is to develop and demonstrate a hypersonic, air-breathing propulsion technology using liquid hydrocarbon (H/C) fuels. As the principal metric, a first-generation hydrocarbon-fueled, scramjet-integrated engine demonstrator will demonstrate sufficient thrust for accelerating an air-launched missile from Mach 4 end-of-boost to hypersonic cruise. The specific performance goal is for hydrocarbon scramjet operation from Mach 4 to 8 with the same specific thrust, and at least half the specific impulse of an equivalent hydrogen scramjet. Completion of this effort in FY02 will benchmark the initial state-of-the-art technology for hydrocarbon-fueled scramjet air-breathing propulsion.

This DTO will enable the development of revolutionary systems that satisfy a number of joint warfighting capability needs such as Precision Force, Counter Weapons of Mass Destruction, and Joint Theater Missile Defense. The advantage of a hypersonic cruise missile is to reduce flight times by a factor of 7 below current systems, while increasing terminal kinetic/penetrating energy by a factor of 8. As a result of hydrocarbon fuel's high-energy density (four times greater than hydrogen), it is possible to develop missiles that can be carried on fighter and bomber aircraft. Furthermore, hydrocarbon-fueled systems do not require the complex and manpower-intensive "space launch" operations and maintenance procedures associated with cryogenically fueled systems. As a result, hydrocarbon-fueled weapon systems would be "all up rounds" similar to (C)ALCM/Tomahawk.

Technology developed under NASP offers the possibility of designing a fixed geometry scramjet for operation over an explicit flight corridor (fixed speed and altitude). The technology barrier is the ability to design an expendable/affordable (fixed geometry) H/C-fueled scramjet capable of accelerating an air-launched missile from Mach 4 to 8 hypersonic cruise. The specific challenges are (1) end-of-boost start of the combustor and operation at high dynamic pressure (1,500–2,500 lbf/ft^2) and low-combustor inlet static temperature, (2) fuel injection and stable combustion during dual-mode (sonic/supersonic) combustor operation through the intermediate flight Mach numbers, (3) effective management of the flow-path pressure, shear/skin friction, and recombination losses during high Mach number cruise, (4) thermal management of the integrated airframe/engine configuration throughout the flight corridor, (5) survivability of flowpath structures in a high-temperature ($T > 5,500^{o}F$) oxidizing environment, and (6) realistic simulation of flight conditions in ground-based test facilities.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602269F	1025	7.2	9.8	13.0	13.0	13.9	12.8	13.0
0602203F	3012	1.9	0	0	0	0	0	0
0603216F	2697	0.3	0	0	0	0	0	0
	Total	9.4	9.8	13.0	13.0	13.9	12.8	13.0

AP.18.00 ***Improved JP–8 Fuel.*** By FY00, this DTO will demonstrate the benefits of an improved JP–8 fuel (JP–8+100) with a 100°F increase in thermal stability (from 325°F to 425°F in the bulk; from 400°F to 500°F wetted wall), and offers a 50% increase in heat sink through use of a detergent/dispersant additive package. The additive package (added at a concentration range of 100 to 300 parts per million) will significantly reduce gums, varnishes, and coke in mainburner fuel nozzles, manifolds, augmentor sprayrings/bars, and other fuel system components at a cost of less than $0.001 per gallon of fuel. Deposition in critical fuel system components such as mainburner fuel nozzles can lead to poor spray patterns, causing improper combustion and potential combustor and turbine damage. Deposition in augmentor sprayrings/bars can result in augmentor no lights and low-frequency rumble.

Development of JP–8+100 will result in the return of the thermal margin for the F–22 (and future upgrades) through a 100°F increase in fuel thermal stability and a 50% increase in fuel heat sink. These advances will result in increased fuel efficiency, reduced emissions, and higher performance capabilities for all weapon systems. In addition, for current weapons systems, the increased fuel thermal stability characteristics of JP–8+100 will result in less coke formation in engines and fuel systems, ultimately increasing reliability and mission capability rates and decreasing operation and maintenance costs. Reduced engine fouling and increased turbine engine nozzle cooling will decrease weapon system signature, thereby increasing survivability.

Technical barriers include understanding the fundamental and complex processes by which additives stop the formation of gums, varnishes, and coke in mainburner fuel nozzles, manifolds, augmentor sprayrings/bars, and other fuel system components; developing test methods that simulate aircraft fuel system conditions accurately enough to evaluate the effectiveness of candidate additives; assuring that candidate additives are compatible with both metallic and nonmetallic fuel system materials (to date over 200 materials have been tested); and developing the methodology to quantitatively verify that the additives reduce deposition in fuel systems. The detergents/dispersants used in current candidate additives can emulsify dirt and water in ground fuel handling systems, thereby disarming current filter coalescers. For logistical reasons, fleet-wide conversion will depend upon the development of a new generation of drop-in replacement filters/coalescers that are tolerant of detergents/dispersants yet provide the filtration and water removal required by current and future weapons systems.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602203F	3012	5.2	0	0	0	0	0	0
0603216F	2697	1.9	0	0	0	0	0	0
0603216F	2480	0	1.6	2.1	0	0	0	0
	Total	7.1	1.6	2.1	0	0	0	0

AP.19.00 ***High Heat Sink Fuels (JP–900/Endothermic).*** The objectives are to provide the propulsive energy and heat sink (cooling) capacity required (enabling) for HyTech and IHPTET Phase III advanced air-breathing propulsion systems by FY01 and FY03, respectively. JP–900 will provide about 700-Btu/lb heat sink capacity by remaining stable (no coking or fouling of fuel system components) up to 900°F. With endothermic capability, fuel will provide about 1,500-Btu/lb heat sink capacity by undergoing chemical change at temperatures up to 1200° F.

Application studies indicate that using fuel as a heat sink to cool the cooling air (compressor bleed) for an IHPTET Phase III demonstrator can result in a 5% increase in thrust-to-weight with a 1% reduction in specific fuel consumption while using Phase II materials. This will permit lower development, procurement, and life-cycle costs for advanced propulsion systems. This high heat sink capability (from a hydrocarbon fuel) will also enable Mach 8 scramjet propulsion formerly thought possible only with logistically unacceptable hydrogen fuel.

Technical barriers to providing the required heat sink capacity include preventing coking/fouling (caused by thermal degradation of the fuel as it is heated) in fuel system components; developing lightweight, safe, durable, affordable fuel/air heat exchangers or directly cooled structures that can transfer heat to the fuel at temperatures/pressures beyond the capability of current components; balancing and controlling the fuel flow (engine requirement for propulsive energy) with the heat sink (cooling) requirement of the system; and effectively injecting liquid, vapor, or supercritical fuel (with continually varying density, viscosity, enthalpy, and species) into the combustor.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603216F	2480	0	0	0	1.7	2.0	2.0	2.0
	Total	0	0	0	1.7	2.0	2.0	2.0

CHEMICAL/BIOLOGICAL DEFENSE AND NUCLEAR

CHEMICAL/BIOLOGICAL DEFENSE AND NUCLEAR

CB.02.10 ***Joint Warning and Reporting Network.*** JWARN will provide commanders with near-real-time situational awareness of chemical and biological (CB) hazards by integrating CB sensors with service C^4I systems to provide fully automated and intelligent CB prediction, warning and reporting. By FY97, the objective is to demonstrate the integration of off-the-shelf versions of JWARN Sensor Link (SL), the JWARN Hazard Prediction Tool (HPT), and the JWARN Automated NBC Warning and Reporting System. By FY98, the goal is to identify, test and characterize affordable JWARN SL hardware and software required to network CB sensors with the services' C^4I systems. The FY99 goal is to merge existing hazard prediction efforts to produce a single JWARN HPT to meet all warfighting CB hazard prediction requirements.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	CB2	0.3	0.7	0.7	0	0	0	0
	Total	0.3	0.7	0.7	0	0	0	0

CB.06.12 ***Advanced Lightweight Chemical Protection.*** This DTO will develop and demonstrate materials for a new generation of lightweight chemical/biological (CB) protective clothing ensembles based on selectively permeable membrane technology which will eliminate/reduce the use of carbon in CB clothing. The resulting advanced material system will be 20% lighter in weight than the battle dress overgarment material system, allow selective permeation of moisture while preventing the passage of common vesicant agent, provide protection against penetration by toxic agents in aerosolized form, and provide at least the current level of protection against toxic vapors and liquids. In FY97, the goal is to complete the development and characterization of candidate materials. In FY98, the objective is to scale up to pilot production quantities in commercial width, fabricate overgarments, and demonstrate their efficacy and durability. In FY99, the goal is to integrate advanced membranes with lightweight shell fabrics and novel closure systems into a lightweight CB duty uniform concept. The CB duty uniform will be launderable, 30% lighter in weight, and less bulky than the Joint Service Lightweight Integrated Suit Technology (JSLIST) duty uniform/overgarment system, with equivalent durability, reduced logistics burden, and lower cost. In FY00, concept lightweight CB duty uniforms will be fabricated and demonstrated for their efficacy and durability.

This DTO supports Land Warrior, Air Warrior, Mounted Warrior, JSLIST P^{3}I, Advanced Development Clothing and Equipment, and Engineering Development Clothing and Equipment.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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		CPT Jon Carroll DBBL (706) 545-5988

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	CB2	0.5	0.5	0.5	0.6	0	0	0
	Total	0.5	0.5	0.5	0.6	0	0	0

CB.07.10 ***Laser Standoff Chemical Detection Technology.*** In FY97, the objective is to initiate development of detection algorithms for an active laser detection concept and begin background characterization for optimization of chemical detection algorithms for interferences. By FY98, the goal is to evaluate the feasibility of adding wind shear detection and limited bioaerosol detection (particle sizing) and begin the design of the brassboard for increased range and sensitivity. The FY99 goal is to initiate brassboard build for a multipurpose detector. By FY00, the DTO will demonstrate brassboard capabilities in field testing with sufficient laser power and detector sensitivity to detect agents at a distance of 20 km (a 400% increase from the FY96 baseline) and evaluate sensitivity for "dusty" chemical agent detection.

This DTO supports Joint Service Chemical Warning & Identification LIDAR Detector, Joint Service NBC Reconnaissance System, and Airbase and Shipboard Chemical and Biological Defense.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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		COL John Nelson PM-NBC Defense Systems (410) 671-4056

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	CB2	0.5	1.0	0.8	0	0	0	0
0603384BP	CB3	0	1.7	3.3	5.4	0	0	0
	Total	0.5	2.7	4.1	5.4	0	0	0

CB.08.12 ***Advanced Adsorbents for Protection Applications.*** This DTO will develop advanced adsorbent materials to enhance the chemical agent filtration capabilities of current single-pass filters as well as regenerative filtration systems under development. Advanced adsorbents will result in smaller, lighter weight filtration systems with reduced logistical requirements and reduced combustibility. Development of a noncombustible adsorbent is desirable to eliminate the possibility of a filter fire in the event of overheating resulting from malfunctioning of system components. By FY98, the objective is to complete investigations of relationships between adsorption performance versus adsorbent property, and select desired pore structure, surface characteristics, and impregnant reactivity for effective adsorption of chemical warfare agents by single-pass filters. By FY99, the goal is to prepare candidate adsorbent materials exhibiting the desired properties and initiate agent sorption assessments. The FY00 goal is to complete performance evaluations of candidate adsorbent materials and select the best adsorbent materials for each application. By FY02, the agent filtration demonstration testing of the best adsorbents to validate fulfillment of performance goals will be completed. Suitability of adsorbent material will be demonstrated for use in military collective and individual protection system applications such as armored vehicles, ships, aircraft, shelters, and respirators.

Service/Agency POC	USD(A&T) POC	Customer POC
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		COL D. Newlin PEO-Armored Systems Integration DSN 786-7763
		MG Robert Orton CDRA (410) 671-3447

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	CB2	0.8	1.0	1.1	0.9	1.1	1.2	0
	Total	0.8	1.0	1.1	0.9	1.1	1.2	0

CB.09.12 ***Enzymatic Decontamination.*** This DTO will develop and demonstrate a new generation of chemical and biological warfare agent decontaminants that are nontoxic, noncorrosive, environmentally safe, and lightweight (freeze-dried concentrate). Enzyme-based systems have the potential to reduce the logistical burden by 25- to 50-fold. High-activity G-agent enzymes have been identified and characterized. Several V-agent enzymes have been identified, but their activity will need to be improved. By FY98, the goal is to complete the cloning and expression of the genes for G-agent enzymes. In FY99, development of biochemical and genetic engineering techniques for enzyme purification will be completed. By FY00, the goal is to demonstrate pilot-scale production/purification of G-agent enzymes, select the best-candidate V-agent enzymes, and acquire commercially available enzymes to enhance effectiveness (e.g., cyanidase). During their development, enzyme components will be evaluated for potential use in surface decontamination of sensitive equipment and other applications. In FY01, the objective is to produce sufficient V-agent enzymes to optimize their use in foam-based dispersion systems. In FY02, the goal is to demonstrate the efficacy of enzymatic decontamination systems for G- and V-type nerve agents in foam.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	CB2	0.8	0.8	0.8	0.8	0.8	0.9	0
	Total	0.8	0.8	0.8	0.8	0.8	0.9	0

CB.10.07 ***Nuclear Hardness and Survivability Testing Technologies.*** This DTO will perform technology development to supplant nuclear testing and thus ensure confidence in the safety, security, and effectiveness of the nuclear posture review stockpile, and validate system survivability and operability in the threat environments produced by proliferant weapons. The program will demonstrate system-scale effects simulation by increasing available x-ray fluence area products by 400%, implementing major improvements in x-ray fidelity, improving plasma sources, increasing by a factor of 10 debris-free soft x-ray testing areas, and increasing by 50% the power flow efficiency and control of pulsed power sources. These demonstrations will have the effect of increasing confidence in assessing survivability criteria by 25%. By FY97, the goal is to develop non-ideal airblast simulation capability at LB/TS and complete safety assessment for strategic aircraft. In FY97, the program will conduct tests for the Navy to assess the survivability of reentry bodies on the Trident missile. By FY98, the program will transition new nuclear system physical security technologies to the Air Force and Army and begin operating the first quadrant of the DECADE x-ray simulator at AEDC. This program collaborates with DOE stockpile dual revalidation through FY05; the plan is to continue weapons system safety assessments, probabilistic risk assessments, and technical base data studies to support ATSD(NBC), CINCs, and the services through FY05. Credible nuclear capabilities are needed for accomplishment of military objectives.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Mr. Matt Holm DSWA/XP (703) 325-0818		COL Terrence Crossey USAF MMIII SPO DSN 458-1980	Mr. Douglas Burdette Army SSDC (205) 955-1896

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602715H	AB	33.1	39.7	38.0	36.9	33.4	32.9	33.1
0602715H	AC	6.3	8.5	8.7	8.2	8.3	8.5	8.6
0602715H	AE	7.1	8.3	8.5	9.0	9.1	9.3	9.5
0602715H	AF	5.4	7.0	6.0	6.1	6.3	9.5	9.7
0602715H	AL	2.9	2.4	2.4	2.4	2.4	2.4	2.4
	Total	54.9	66.0	63.6	62.5	59.4	62.4	63.3

Note: Totals may not add due to rounding.

CB.12.01 ***Electronic System Radiation Hardening.*** This DTO will develop technology to enable production of affordable state-of-the-art, radiation-hardened microelectronics and design and test protocols to enable DoD systems to survive and perform their mission in natural and nuclear weapons-generated radiation environments. The enabling technology effort develops advanced materials, process and design methods to enhance radiation robustness, and test and measurement methods to characterize microelectronics radiation performance. Additionally, this program addresses design and test protocols emphasizing radiation hard design techniques and the minimum set of tests required to validate system hardness across a wide spectrum of nuclear threats using currently available facilities. This enabling technology forms the basis from which DTO SE.37.01, High-Density Radiation-Resistant Microelectronics, produces final products with system program office funds.

Specific technology objectives include the development of microelectronics-enabling technologies and materials. Static random access memories (SRAM) will be the technology vehicle to produce a broad range of radiation-hardened digital and analog microelectronics. By FY98, the goal is to demonstrate and test radiation-hardened silicon-on-insulator analog microelectronics. By FY99, the program will demonstrate radiation-hardened submicron (0.35 micron) technology for 16 times reduction in weight and power. By FY00, the program will demonstrate deep submicron (0.25 micron) technology for radiation-hardened low-power 1,000 k gate array and 16M SRAM technology for 100 times reduction in weight and power.

This DTO will develop affordable design and test methodologies for radiation-hardened spacecraft, missile interceptor, sensors, and optical materials without the use of UGTs. Protocols for each area will define testing for a verified survivable system. By FY97, the program will design test coupons and conduct characterization of optical materials and ensemble-level testable hardware protocol validation testing. By FY98, final, validated spacecraft and missile interceptor protocols will be delivered. The FY99 goal is to demonstrate an optical material systems-level analysis predictor and deliver a final, validated sensor protocol.

This program develops the enabling technology for critical path radiation-tolerant items essential for the Space-Based Infrared System and USSTRATCOM priority weapon systems and C^4I systems. Survivable space-based systems are preconditions for accomplishing the JWSTP objectives of dominant battlespace knowledge and prevailing in information warfare.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602715H	AF	19.7	21.6	23.9	26.8	28.9	29.6	30.2
Total		19.7	21.6	23.9	26.8	28.9	29.6	30.2

CB.13.07 *Hard-Target Defeat.* This DTO develops the technology base required to characterize, to disrupt or defeat, and to assess battle damage for buried or hardened targets, particularly targets containing weapons of mass destruction (WMD). The warfighting CINCs have identified defeat of underground targets as one of their top priorities.

By FY97, the program will continue support of the hard and deeply buried target defeat capability (HDBTDC) acquisition program with phenomenology scale and field testing to evaluate 60 candidate concepts; co-chair an intelligence, surveillance, and defeat assessment working integrated product team to optimize weapon effectiveness; and develop an automated engineering tool to identify and exploit vulnerabilities in underground facilities. Field and lab phenomenology tests will be conducted to characterize blast, fire, and fragmentation environments in tunnels, and to evaluate weapon penetration in at least two rock geologies. By FY98, the program will develop geoengineering models describing warhead penetration and damage propagation, and include a target planning tool in the tunnel module of the Munitions Effectiveness Assessment (MEA). The program will continue evaluation of new concepts from the HDBTDC program, with analyses and testing of weapon/target interaction, enhanced payloads, and target fragility; conduct field tests on target subsystems, including blast doors, vehicles, and equipment; collect and evaluate target and event surveillance signatures; and perform tests and demonstration for functional kill of missile tunnel facilities. By FY99, the program will demonstrate a capability to deny and disrupt operational tunnel facilities, such as Scud missile tunnels, for a minimum of 48 hours; and develop target reconstitution models for incorporation in the MEA target planning tool. FY00 goals are to demonstrate significant improvement in the ability to characterize the function and physical layout of underground targets; and demonstrate a capability to deny and disrupt WMD production and storage facilities located in tunnels for at least 48 hours.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602715H	AC	3.2	4.4	4.3	3.8	4.0	4.1	4.1
0602715H	AI	5.8	9.7	10.4	11.8	12.4	12.6	12.9
	Total	9.0	14.1	14.7	15.7	16.3	16.7	17.0

Note: Totals may not add due to rounding.

CB.14.07 ***Prediction and Mitigation of Collateral Hazards.*** This DTO will establish the capability to accurately predict the effects on civilian and military populations of weapons of mass destruction (WMD) hazards released into the atmosphere due to conventional counterforce attacks on WMD facilities.

By FY97, the program will demonstrate a significant improvement in the ability for long-range, high-resolution forecasting of WMD hazards, including capability for high-resolution mesoscale weather prediction and calculation of mass consistent wind fields. By FY98, the goal is to extend the capability to model non-weapon-related sources (including accidents and terrorist devices), and validate the use of such calculations to accurately predict transport and tracking over long (1,000 km+) ranges. By FY99, the program will integrate the natural hazard capability with the capability for predicting WMD hazard health impacts, and calculate mean depositions and probabilities of detection or kill while estimating weather uncertainty. The FY00 goal is to demonstrate a significant improvement in the ability for long-range, high-resolution forecasting of WMD health hazards (rain-out and scavenging). By FY01, the program will demonstrate an integrated, automated capability for predicting collateral hazards to human populations resulting from attacks on WMD targets and possibly the dispersal of chemical or biological agents and radiation. The emphasis will be on operational deployment of advanced weather prediction capabilities in the field. The FY02 goal is to conduct scale tests for WMD source models from attacks by enhanced weapons. By FY03, the program will validate prediction methodology using scaled tests of nuclear weapon storage facilities and hardened targets such as tunnels.

This program responds to two JWCOs, Counter Weapons of Mass Destruction and Chemical/Biological Warfare Defense and Protection. Detection and characterization of agent hazards was the top priority defined by the CINC warfighters in their articulation of areas in which capability enhancements are needed.

Service/Agency POC	USD(A&T) POC	Customer POC	
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		Mr. John Ainsworth SD/AFRRI (301) 295-1211	

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602715H	AC	0.8	1.0	1.3	1.5	1.6	1.6	1.7
0602715H	AF	2.0	2.2	2.2	2.7	1.4	1.1	1.1
	Total	2.8	3.1	3.4	4.2	3.0	2.7	2.8

Note: Totals may not add due to rounding.

CB.15.01 ***Balanced Electromagnetic Hardening Technology.*** This program responds to requirements identified by JCS/J–6, USD(A&T) et al. A minimum/baseline program would, by FY01, develop and demonstrate innovative, affordable technology and methodologies for integrated hardening and testing of military systems against high-power microwave (HPM) and high-altitude electromagnetic pulse (HEMP) effects. Integrated hardening against multiple battlefield threat environments (e.g., HPM and HEMP) will reduce hardening cost, size/weight, and procurement (design and test time), and provide residual protection against other electromagnetic threats (e.g., indirect lightning). Hardening cost reductions of up to 30% can be achieved if composite shielding materials become realizable. Cost savings of 20–25% over the life of a system are also expected with the improved testing and maintenance/surveillance methodologies developed under this program. An integrated approach to hardening against a range of effects is both more cost-effective and prudent, given the anticipated increased use of commercial parts and specifications in DoD acquisitions and wider frequency range of possible battlefield electromagnetic environments.

Specific technology objectives include developing a PC-based EMP environment/coupling code and PC-based EM protection tool, and complete development of unified EMP/HPM protection and test methodology by FY97. By FY98, the goal is to develop a wide-band (affordable) SE test method. By FY99, the program will demonstrate new EMP/HPM hardening technologies/test techniques. By FY00, integrated EMP/HPM test methods will be demonstrated; by FY01, proven EMP/HPM hardware and software technologies and test techniques will be transferred to the services.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602715H	AF	2.2	2.3	2.5	2.5	2.5	2.5	2.6
	Total	2.2	2.3	2.5	2.5	2.5	2.5	2.6

CB.16.12 ***Enhanced Respirator Filtration Technology.*** This DTO exploits the latest filter technologies, including low-resistance electrostatically charged HEPA-quality media and flexible, moldable carbon adsorbent structures, to develop a filter system capable of meeting all the filter requirements of the Joint Service General-Purpose Mask (JSGPM). These requirements include lower breathing resistance and lower profile. In FY97, the objective is to design and evaluate candidate filter concepts for the JSGPM mask capable of meeting C2 canister agent vapor and aerosol filtration requirements. A mask filter capable of providing full-threat NBC protection while offering a 50% reduction in airflow resistance and a 33% reduction in overall profile will be demonstrated in FY98.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	CB2	1.0	0.9	0	0	0	0	0
	Total	1.0	0.9	0	0	0	0	0

INFORMATION SYSTEMS TECHNOLOGY

INFORMATION SYSTEMS TECHNOLOGY

IS.01.01 ***Consistent Battlespace Understanding.*** This DTO will provide warfighters with critical, tailored battlespace information including enemy, friendly, temporal, and spatial information, while maintaining consistency of view across echelons, joint unit types, and battlespace position. The intent is to speed understanding and organize, fuse, assess quality, deconflict, handle uncertainty, and present information to ensure thorough situation and battlespace understanding.

This DTO overcomes current limitations in the management and display of complex tactical information and addresses problems associated with differing perceptions of battlespace status; the depiction of aging, conflicting or uncertain data; data omissions; and depth of understanding. It facilitates rapid, effective decisions, resulting in improved force synchronization, reduced casualties, and faster realization of operational objectives. Required technologies include geo-information systems, uncertainty visualization, spatial- and temporal-based reasoning, knowledge bases, constraint-based and goal-directed reasoning, improved hardware performance, MMI innovations (3D/4D virtual and augmented reality, speech understanding, natural language and gesture/touch recognition, 3D audio, etc.), distributed/collaborative situation assessment, intelligent sentinels for alerts, mathematical modeling, and automatic target recognition.

During FY97, the program will develop and demonstrate case-based situation assessment tools and smart presentations depicting uncertainty, discontinuities, and temporal and spatial anomalies. It will address the issue of data quality due to sensor fidelity, reporting dropouts, network latency, etc. The FY98 goal is to develop and demonstrate a Joint Task Force battlespace awareness and visualization capability providing a consistent, accurate, comprehensive, and timely battlespace picture (C^2, intelligence, logistics, weather, obstacle, etc.). This picture will provide selectable detail and resolution and remote information links to continuously acquire and fuse multisensor/multimedia data with levels of uncertainty. By FY99, the program will demonstrate automated, integrated situation assessment and display applications, in addition to adding automated data validation and representation; intelligent agents for information retrieval, filtering, deconfliction, and mission-tailored presentation; and large, distributed databases. By FY00, the goal is to complete integration of automated capabilities across services and disciplines (maneuver, air-strike, naval, (littoral), intelligence, communication, transport, etc.) and demonstrate these capabilities in joint exercises, proving the ability to access and employ foreign, digitized/nondigitized, or commercial data for military purposes. The FY01 goal is to incorporate image understanding and multilingual speech and text understanding for joint and coalition operations worldwide. By FY02, the program will demonstrate fully automated situation assessment applications which fuse, assess, and innovatively present enemy intent and potential actions based on knowledge bases, encoded doctrine, constraint-based reasoning, and fused historical, political and military databases of regional activities; and will provide 3D/4D immersive interfaces to aid and speed cognition.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603760E	CCC-02	15.2	10.0	8.0	5.0	0	0	0
0603772A	101	3.5	3.7	4.3	4.3	3.7	0	0
0602232N		0.4	0.5	0.6	0.7	0	0	0
0602232N		0.5	0.5	0.6	0.7	0.7	0.7	0
0602232N		0.3	0.5	0.5	0.3	0.3	0.3	0
0603617F	2321	0.4	0.6	1.0	0.6	0.3	0	0
0603789F	2335	0.5	0.5	0	0	0	0	0
	Total	20.8	16.2	15.0	11.6	5.0	1.0	0

Note: Totals may not add due to rounding.

IS.02.01 ***Forecasting, Planning, and Resource Allocation.*** The goal of this DTO is to provide warfighters with a proactive planning process to avoid direct conflict and to be prepared to act and react should conflict prove inevitable. This will be achieved through coordinated actions prior to the commencement of battle, or the next phase of the battle. The forecasting, planning, and resource allocation (FPRA) program provides warfighters with the ability to fuse and assess data, generate constraint/goal-based options and alternatives, plan the allocation and assignment of resources to shape expected actions within the enemy's decision cycle, reduce planning cycle times, and deny the enemy the time and means to respond with a counterattack plan. This DTO will reduce casualties and fratricide, provide rapid battle-activity response, and reduce by 50% overall planning/replanning time.

By FY97, FRPA will provide products to serve as a model for lower echelon mission planning systems. By FY98, the program will develop and demonstrate an automated real-time capability to analyze and select alternative courses of action, construct and analyze forecasts, prioritize critical objectives, and develop plans to permit rapid rehearsal and evaluation of battlespace options. This development includes collaborative distributed planning and scheduling, negotiation, automated target/shooter pairing, problem detection and alerting, and interactive wargaming as an integral part of the rehearsal process. By FY99, FRPA will reduce the in-theater footprint of the Joint Force Air Component Command Air Operations Center by 60%. Planning will leverage the development of intelligent agents to initiate and sustain planning and forecasting. The FY00 goal is to reduce Tanker/Airlift Control Center staff by 40%, employ automated templates for generic mission planning, and utilize advanced knowledge bases for recognizing and predicting friendly and enemy force patterns and activities. FPRA will enable constraint/goal-based automated plan development for the CJTF, including collaborative development of multimedia operations orders and fragmentation orders, automated route planning for fighting and supporting units, and automated ISR/SEAD planning for ground, sea, and air-based platforms. Required technologies include modeling and simulation tied to geo-information systems, uncertainty visualization, spatial- and temporal-based reasoning, resource conflict resolution, knowledge bases, neural nets, Petri nets, constraint-based and goal-directed reasoning, improved speed and capacity hardware, MMI innovations, real-time distributed/collaborative planning and negotiation, intelligent agents for alerts and for data mining, search and retrieval, and mathematical modeling.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602301E	ST-11	7.5	10.4	5.0	5.0	5.0	5.0	5.0
0602702E	TT-03	6.8	8.7	6.6	0	0	0	0
0603761E	CST-01	2.0	2.0	0	0	0	0	0
0603772A	101	3.5	3.7	4.3	4.3	3.7	0	0
0602782A	779	1.7	2.6	2.9	2.9	3.0	0	0
0602232N		0.1	1.0	0.9	0.9	0.9	0.9	0
0603789F	2335	0.4	0.4	0.2	0.3	0.3	0	0
0603782F	2532	2.1	1.8	1.8	1.9	2.0	2.0	2.1
0603617F	2321	0.4	0.6	1.1	1.3	0.6	0	0
0602702F	5581	1.9	1.9	1.6	1.9	2.2	2.3	2.4
0603794N		1.2	1.2	0.8	0	0	0	0
	Total	27.7	34.4	25.2	18.4	17.6	10.3	9.5

Note: Totals may not add due to rounding.

IS.03.01 ***Integrated Force and Execution Management.*** IFEM will provide warfighters with the ability to monitor, control, and coordinate real-time events inappropriate or impractical for traditional planning and forecasting activities; the ability to accomplish dynamic, continuous synchronization of operations through collaborative execution monitoring, plan-repair, and re-tasking of shared assets across echelons, missions, and forces; and knowledge-based cues for rules of engagement in offensive, defensive, evasive, and deceptive actions. IFEM directly supports the JWSTP objectives for Information Superiority, Joint Readiness and Logistics, and Precision Force. IFEM will implement a capability to perform enhanced wargaming at faster-than-real time. Required technologies and metrics are similar to those addressed by DTOs IS.01 and IS.02.

During FY97, the program will develop and demonstrate real-time, single-echelon execution monitoring tools that display a deviation from plans, and provide automated recommendations for constraint-based or goal-based actions to "get back on track." It will demonstrate en-route/in-stride capabilities that permit similar flexibility afforded encamped forces, and identify and preview modified routes, alternative targets, and threats impacting a repaired plan. By FY98, IFEM will demonstrate the capability to monitor multiple-echelon plans, and perform real-time plan deconfliction across missions and near-real-time battle damage assessment. FY99 goals are to provide automated implementation of tactical contingency plans and synchronization with other ongoing elements; to provide collaborative execution monitoring among echelons and forces, incorporate uncertainty measures into plan repair functions, and integrate decision support for ISR and logistics operations linked with the ongoing battle; and to develop the capability to incorporate signature/spectrum management and the effects of sensor position options into the ongoing battle. By FY00, IFEM will demonstrate in-stride retasking/retargeting/weaponeering for multiple, dispersed units, including collaborative sensor detect/track, automated target assignment and engagement, and cooperative engagement and target handoff. By FY01/02, the program will provide four-dimensional representation of battle execution management. Fully coordinated operations across the force will result in faster adjustment of mission plans, a reduction in casualties and fratricide, and an improvement in force synchronization.

Required technologies include advanced applications such as modeling and simulation tied to geo-information systems, uncertainty visualization, spatial- and temporal-based reasoning, multivariable conflict resolution, knowledge bases, neural nets, Petri nets, constraint-based and goal-directed reasoning, improved speed and capacity hardware, display and MMI innovations, real-time distributed/collaborative planning and negotiation, intelligent agents for alerts and for data mining, search and retrieval, and mathematical modeling, real-time geo-referenced imagery, ATR and intent analysis, nodal analysis, etc.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603772A	101	3.5	3.7	4.3	4.3	3.7	0	0
0602782A	779	1.7	2.6	3.0	3.0	3.0	0	0
0602232N		1.6	2.2	1.7	0.8	0.3	0.3	0
0603617F	2321	1.1	1.3	1.4	1.3	0.8	0	0
0603789F	2335	0.1	0.1	0.8	1.3	1.8	0	0
	Total	8.0	9.9	11.2	10.7	9.6	0.3	0

IS.10.01 ***Simulation Interconnection***. The goal of this DTO is to facilitate the interoperability of simulations. The program will provide users the capability to connect diverse joint and component simulations, in a composable fashion, to support the functional areas of training, acquisition, and analysis. The major technical challenges include establishing the architectural design, protocols and standards, and security to facilitate the interoperability of simulations; developing the supporting infrastructure software to apply the architecture to simulation application with the needed levels of performance; and extension of the architecture to provide advanced time management, data distribution, and federation management services.

In FY97, the program will develop first-generation runtime infrastructure, develop and test initial prototype object model development software, investigate innovative techniques for supporting scaleable executing systems using a high-level architecture (HLA), and develop an automated high-level architecture compliance testing capability. Runtime infrastructure capabilities will represent a 20% improvement in performance over proof-of-concept prototypes, and development tools will reduce object model development time by 25%. In FY98, the program will design and develop innovative industry-based runtime infrastructure software demonstrating increased performance (25% improvement) and broad-based portability (reduce cost of porting by 25%); extend HLA services to address user needs in advanced time, data distribution, and federation management (increasing user base by 10%); and demonstrate technologies to support larger scale federations (10% increase). FY99 goals include development of prototype for initial automated tools to support federation development (reducing time to create a new federation by 20%), and advanced system planning and runtime management tools to support the efficient operation of large-scale applications (20% less manpower). In FY00, increased advanced integrated automation will be applied to federation development and operation, demonstrating additional (20%) reduced costs to create a new federation. In FY01, runtime infrastructure advances using next-generation software and hardware will demonstrate increases (20%) in performance for the same cost, using readily available COTS software to replace 50% of custom software. In FY02, advanced support software will demonstrate automation of the end-to-end process of identifying candidate simulations; defining runtime data exchange requirements, network and computer resource requirements, configuration, operation, and monitoring of federation operation; and demonstrating a substantial decrease (50%) in time and manpower to support user application.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603238D	P476	20.1	22.5	10.5	9.3	9.4	9.5	10.6
	Total	20.1	22.5	10.5	9.3	9.4	9.5	10.6

IS.11.01 ***Simulation Information Technologies.*** The goal of this DTO is to provide the services and government agencies the ability to develop simulations that provide consistent and reliable results, through the development of common conceptual models of the mission space (CMMS) using authoritative representations. Common syntax and semantics will be developed to specify the warfighter mission (the entities, their actions and interactions) to the simulation developer, and to formulate and define standard data structures, dictionaries, and enumeration of complex modeling and simulation (M&S) data (e.g., highly derived data, command hierarchies, artifacts of legacy systems). This objective includes the development of an M&S resource repository; and joint verification, validation, and accreditation/certification (VV&A VV&C) standards and guidelines. Developing coherent, complete, and consistent CMMS is an extensive task. DoD M&S spans a wide range of missions, from conventional to other-than-war missions; and M&S applications, from system acquisition activities to mission planning and rehearsal. The distributed and interactive nature of advanced M&S capability and security concerns makes the standardization and ready availability of standardized data an extremely complex technical concern.

In FY97, the initial prototype of CMMS will be developed and will demonstrate distributed data collection for Joint Task Force-level exercises. In FY97/FY98, prototype conceptual models of the mission space will be available for use by the Joint Simulation System, Warrior Simulation 2000, National Air Space Model, and the Joint Warfare Simulation. The M&S VV&A recommended practices guide will be published. Pilot studies on the impact of security policies will be completed. Pilot studies of M&S VV&C procedures and guidelines will be initiated. The FY98 goal is an improved simulation infrastructure for 50,000 object exercises generating 500 GB of data. By FY99, the program will implement improved representations of synthetic environments in an updated compact terrain database format. Techniques for modeling complex data structures initiated in FY96 will be demonstrated and completed in FY00. By the FY00 timeframe, at least 50% of the major simulation program developers will have contributed to population of the CMMS. Conceptual models of the mission space will be used by the warfighter in validating doctrine, functions, tactics, techniques, and procedures. By FY02 and beyond, CMMS will represent DoD activities, and warfighters will have worldwide access to conceptual models of DoD processes. These new capabilities are focused on supporting modeling and simulation system developers in providing operationally valid, consistent representations of functional roles and relationships. These efforts will specifically support the Synthetic Theater of War ACTD.

Service/Agency POC	Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603761E	CST-01	6.7	13.0	12.9	0	0	0	0
0602702E	TT-06	1.9	0	0	0	0	0	0
	Total S&T	8.6	13.0	12.9	0	0	0	0
0603832D*	P476	15.1	16.7	19.5	19.7	21.3	22.9	22.9
	Total	23.7	29.7	32.4	19.7	21.3	22.9	22.9

* Non-S&T funds.

IS.12.01 ***Simulation Representation.*** This DTO will enhance the realism of models and simulations used in military training, acquisition, and analysis by providing authoritative representations of (1) static and dynamic, natural, and man-made environments, and related effects on human and system performance; (2) the performance and capabilities of warfighting systems and their effects on natural and man-made environments; and (3) human behavior (individual and group). Representations of the terrain, ocean, atmosphere, and space are often at a large data volume with great diversity, accounting for large numbers of significant conditions and effects. Major challenges include rapid database generation and near-real-time interaction of consistent and correlated representations. The representation of human behavior must reflect the effects of the capabilities, limitations, and conditions that influence human behavior (e.g., morale, stress, fatigue). Providing variable human behavior for friendly, enemy, and non-hostile forces—to include computer-generated forces (CGFs) that exhibit platform-based behavioral modeling and command forces (CFOR) models through division level—remains a significant challenge.

In FY97/FY98, this DTO will provide (1) a capability to rapidly generate terrain databases for a 2,500-km^2 area to support a 72-hour crisis rehearsal; (2) enhanced system representations, under development by the services; (3) tools and technical methods used to acquire knowledge and better represent human (individual and group) behavior; and (4) extend CFOR command entities to battalion level and demonstrate the rapid generation of CGF adaptive behaviors. FY99/01 developments will include (1) the capability to generate and interchange integrated consistent synthetic environments (terrain, oceans, atmosphere, and space) at multiple resolution within 72 hours; (2) representations of the effects of human C^2 decision-making processes in company- and battalion-level surrogates, and providing more variable, less deterministic individual and group behaviors. In the FY02+ timeframe, DTO-developed tools will enable dynamic, scaleable (micro to macro) adjustments to the synthetic environmental representations in simulations running in real time, and representations of the C^2 decision-making process will be extended to the brigade, division, and corps surrogate levels.

These efforts will specifically support the Synthetic Theater of War (STOW 97) ACTD and joint modeling and simulation system developments like JSIMS, JWARS, JCOS, JLOTS, improved CGFs, and C^{4}ISR interfaces, as well as DoD's battlefield visualization program. Coordination of efforts is essential with the Sensors, Electronics and Battlespace Environment technology area, and the Rapid Battlefield Visualization (RBV), Battlefield Awareness and Data Dissemination (BADD), and STOW ACTDs.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602715H	AB	3.1	3.4	3.7	4.0	5.6	7.4	9.4
0602308A	C90	0.8	0.8	0.8	0.8	0.9	0	0
	Total S&T	3.9	4.2	4.5	4.8	6.5	7.4	9.4
0603832D*	P476	17.7	25.8	37.4	40.7	41.2	41.1	41.9
	Total	21.6	30.0	41.9	45.5	47.7	48.5	51.3

*Non-S&T funds.

IS.13.01 ***Simulation Interfaces***. This DTO will provide simulation interfaces for the seamless integration and composability of federations of modeling and simulation (M&S) applications with live systems, instrumented systems on test and training ranges, and humans. This critical capability will facilitate the use of M&S in providing consistent battlespace understanding, integrated force management, and predictive planning (Reference DTOs IS.01, .02, and .03) and will augment the decision-making process. Two of the primary advantages are the ability to take M&S to war and to train as you intend to fight (i.e., using M&S to provide realistic loads on operational C^4I systems). This technology will facilitate the use of M&S in mission rehearsal; provide additional information to operational planners on weapons effects, sensor capabilities, etc.; provide additional insights/analysis regarding operational plans, potential dangers, conflicts, losses, and effectiveness; enhance distributed, collaborative planning; provide live system processes and activity representations in simulation exercises; represent simulated entities to operational live systems; and represent warfighters in distributed simulations. Four classes of interactions between C^4I systems and simulations will be demonstrated: (1) C^4I as a stimulator, (2) C^4I system as a viewer, (3) live C^4I player, and (4) virtual C^4I player. Common operational modeling planning and simulation strategy (COMPASS) services (collaborative session management, geo-registered overlay management, analysis, composite mission preview, and simulated mission rehearsal capabilities) will focus on the first two classes, while the development of a Modular Reconfigurable C^4I Interface (MRCI) will focus on the latter two. Technical challenges include (1) modular interfaces that are responsive, easily reconfigurable for multiple like or heterogeneous live systems (as opposed to bilateral interfaces), and compliant with the JTA and the M&S common technical framework; (2) the accurate representation of live platforms and humans in a simulation; and (3) realistic presentation of synthetic forces to live platforms and humans.

In FY97, the program will demonstrate an HLA-compliant prototype MRCI for a few C^4 systems (AFATDS, MCS, CTAPS). By FY98, MRCI will be further developed to support larger numbers of C^4I systems. Interfaces are planned for JSIMS and GCCS. In FY98, the goal is to demonstrate a 100% increase in USMTF, VMF, and TACFIRE message set size, and to integrate MRCI capability and COMPASS services to develop a comprehensive set of M&S services within DII COE Version 3.0. In FY99–01, the program will expand upon the success of the MRCI to develop bidirectional reconfigurable interfaces to other live weapons and sensor systems and test and training ranges. In FY02, the goal is to initiate development of reconfigurable simulation interfaces to support the full immersion of humans into the synthetic environment.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603832D*	P476	6.3	6.1	7.1	7.3	7.4	7.5	7.6
	Total	6.3	6.1	7.1	7.3	7.4	7.5	7.6

*Non-S&T funds.

IS.15.01 ***Assured Distributed Environment Support.*** This DTO will develop and demonstrate a globally distributed, heterogeneous information infrastructure to provide warfighters at all echelons immediate and location-transparent access to information. It may be derived from multi-terabyte databases spread over a thousand nodes, and involve execution and sharing of up to one-half million processes, supporting all phases of mission planning and execution. This allows users to craft their C^4I information environment from the full set of assets connected through the grid. It will be dynamically reconfigurable to accommodate crisis loads, outages, or changes in information needs, and will support collaboration among all elements of planning, decision making, and execution monitoring and assessment including information discovery and retrieval in massive, heterogeneous, distributed environments. The information infrastructure will support deployed operations with a small footprint and maximum reach-back to in-garrison resources, and provide for the seamless integration of processing and communications systems, plus associated information services and applications as described in the Advanced Battlespace Information System (ABIS). This DTO relates to DTOs A.13 and IS.21. By FY97, the program will demonstrate heterogeneous, distributed computing (involving up to 30 nodes over three heterogeneous wide-area networks) incorporating multimedia data, shared-context collaboration, video conferencing, and intelligent-agent-based data acquisition over wide-area networks. By FY98, the goal is to demonstrate incorporation of mobile computing nodes into the infrastructure. This includes operation over combat net radio (4,800 b/s) bandwidth, more error-prone communication channels, protocols to allow entry/departure (within 2 minutes) and re-entry into the configuration, and resource management mechanisms to allow allocation and binding of 1,000 processes and associated data across the hybrid fixed/mobile configuration. The FY99 goal is to implement up to four virtual, collaborating, planning teams with shared access to up to six collaborative planning domains, with full traceability from strategy to task. By FY00–FY03, the program will demonstrate adaptive reconfiguration of a 100-node infrastructure to support dynamic crisis response. Technical barriers include system state management to support dynamic reconfigurability for the formation of virtual collaboration teams; scalability of resource control mechanisms for up to 10,000 objects across 100 nodes; algorithms to maintain quality-of-service parameters across a widely disparate communications backbone; and dynamic binding of heterogeneous processes and databases across multicluster infrastructure.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602301E	ST-19	6.9	5.2	0	0	0	0	0
0603760E	CCC-01	9.5	5.0	0	0	0	0	0
0603761E	CST-02	13.0	4.0	0	0	0	0	0
0602702F	5581	3.0	2.3	2.2	1.7	1.8	1.9	1.9
0603728F	2530	1.9	1.3	1.5	0.9	0.7	1.2	1.2
0602232N		2.8	3.1	4.0	4.0	4.0	4.0	4.0
0602783A	094	1.6	1.8	0	0	0	0	0
	Total	38.7	22.7	7.7	6.6	6.5	7.1	7.1

IS.17.01 ***Defensive Information Warfare.*** This DTO will develop and demonstrate technology to provide a degree of control in information functions found in processes and applications above the transport layer that permit friendly forces to operate at a given time and place without prohibitive interference by the opposing force. The program will develop and demonstrate technology to guarantee availability and integrity of the information system to support the warfighter in a dynamic battlefield environment; monitor the system health relative to an objective policy, and modify allocation of resources to accommodate any changes or anomalous behavior; provide graceful degradation of performance for system under attack, and ensure that depleted resources are dynamically allocated the highest priority mission support; and increase the number and type of faults the information system can tolerate, and minimize recovery time and residual effects of the recover mechanisms. This DTO supports A.04, A.12, and IS.21.

By FY97, the goal is to complete a tool for white-box security evaluation with respect to a threat model. By FY98, the program will release a library of application-embedded network security services; a commercial (B3) certified workstation featuring trued computing base; and prototype CORBA-compliant domain and type enforcement for secure location interoperability. It also will demonstrate integrated security support in prototype extensible operating system; complete design tools for inferring system-level properties in composed systems; demonstrate a primitive survivable immune system for responding to attacks and intrusions; and demonstrate resource allocation mechanisms for an adaptive system of systems. FY99–FY01 goals are to demonstrate a suite of secure, reliable distributed applications over mobile and wireless networks; demonstrate integration of security composition techniques into software engineering tools; demonstrate adaptive architecture for survivable system of systems; and develop techniques for diagnosing multiagent multistaged attack. FY00–01 goals include completing prototype network management implementation for crisis-mode operation; demonstrating techniques for general three-way tradeoffs among fault tolerance, real time, and security; applying assurance and evaluation tools to secure fault-tolerant operating systems and network services; and demonstrating and red-teaming survivable architecture integrating adaptive protocols, immune system technologies, and secure distributed services. The primary technical barrier here is assuring the confidentiality and integrity of data at multiple classification levels in systems accessed by users with different clearances and need-to-know.

Service/Agency POC	Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602301E	ST-19	1.3	0.9	0	0	0	0	0
0602301E	ST-24	29.8	43.3	45.8	50.1	55.0	0	0
0603760E	CCC-01	3.7	15.0	20.0	25.0	0	0	0
0603728F	2530	0.4	0.3	0.4	0.4	0.4	0	0
0603794N		0.7	0.7	0.7	0	0	0	0
0602232N		1.0	1.1	1.4	1.6	1.5	0	0
0602234N		1.0	1.2	1.6	0	0	0	0
	Total S&T	37.9	62.5	69.9	77.1	56.9	0	0
0303140F*		5.6	6.3	6.8	7.7	7.7	0	0
0303140N*		1.5	1.3	1.3	0.9	0.9	0	0
0303140G*		1.2	1.0	1.0	0	0	0	0
	Total	46.2	71.1	79.0	85.7	65.5	0	0

*Non-S&T funds.

IS.20.01 ***Universal Transaction Communications.*** This DTO will provide warfighters the ability to exchange information, unimpeded by differences in connectivity or interface characteristics; enhance dissemination throughput and connectivity to meet most warfighter needs; provide fully integrated asymmetric services; provide high-capacity, flexible, tactical communications extensions to serve all categories of uses; develop universal transaction protocols and standards providing seamless connectivity across multiple media; and provide automated features to mitigate the effects of man-made and naturally disturbed environments on wireless communications.

By FY97, the program will demonstrate a bandwidth-adaptive multimedia node for mobile computing, advanced mobile networking algorithms, and protocols and transparent relocation within a mobile environment. By FY98, the goal is to demonstrate wireless internet gateways (WINGS) needed to enable seamless marriage of distributed, dynamic, self-organizing, multihop, wireless networks with emerging multimedia internet; a scaleable architecture that can support wireless access across multiple overlay networks while delivering high levels of end-to-end performance; and a prototype low Earth orbit payload to support a direct-broadcast satellite using an adaptive spread Aloha protocol. The FY99 goal is to demonstrate distributing in a multihop environment and an integrated high data rate untethered node. In FY00, the program will demonstrate high-performance mobile wireless networks. FY00/FY01 efforts will focus on exploiting code division multiple access, wideband CDMA, and application specific integrated circuits to insert technology into Army Land Warrior and Marine Corps systems. Efforts in FY02/FY03 will focus on signal conditioning, adaptive conditioning and adaptive addressing technologies to provide seamless connectivity across multiple systems. Technical barriers include protocols and network control for high-population, high-capacity mobile networks; null steering antenna algorithms; multimedia over low data rate channels; and overcoming current limitations in data rates, range, power consumption size, connectivity and multimedia services in the mobile, wireless environment by providing rates greater than 1 Mb/s, ranges greater than 10 km, power consumption greater than 24 hr, and multihop efficiency greater than 30%. This will enable the warfighter to develop concepts and plans without imposing constraints on thought processes by providing seamless connectivity, automatic information conditioning, location-independent personal and group addressing, and flexible adaptive access control.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602782A	H92	0.6	0.7	1.4	2.4	2.7	0	0
0603006A	247	0	0	0	0	0	5.5	8.0
0603006A	257	0	0	0	5.0	5.0	6.0	5.0
0602301E	ST-19	18.0	18.3	27.0	42.5	0	0	0
0602232N		0.6	0.7	0.7	0.6	0.6	0	0
	Total	19.2	19.7	29.1	50.5	8.3	11.5	13.0

IS.21.01 ***Assured Communications.*** This DTO addresses near-term issues and provides a technology feed for the Joint Warfighter Information Security ACTD. It involves technology development to detect and characterize attacks at the network and lower transport layers. It will also provide high-quality services that will be available as needed; that can be adapted, scaled, and projected to meet dynamically changing demands; and that can be defended against physical, electromagnetic, and information warfare (IW) threats. The program will provide modular plug and play for C^4I commensurate with force package modularity to allow adaptation of services; support multilevel security; provide defensive IW to ensure active and passive protection; demonstrate IW surveillance and defense tools to detect, classify, and respond to IW attacks; integrate existing information security devices to provide a suite of operational capabilities for joint and coalition operations; and provide capability for automated communications subsystem selection based on threats, scenario, and intended recipient. The extent, effectiveness, and quality of this protection is measurable in terms of required distance (200 km) from jammers of various power levels (100 W); time (less than 30 seconds) needed to detect, correlate, and characterize IW events; time (10 seconds) to coordinate and respond to IW attacks; time (less than 10 seconds) needed to restore communications connectivity in the face of attack; and measured throughput (1.5 Mb/s) before, during, and after IW attack and response.

By FY97, the program will demonstrate secure guards and firewalls at B3 level of service. Multilevel security requirements will be addressed by the insertion of tactical end-to-end encryption device (TEED) hardware into Task Force XXI. TEEDs to support the tactical internet protocol internetwork should be available for user testing in FY97. Following successful development and testing, TEED will be upgraded to support asynchronous transfer mode cell encryption using Baton technology in FY98. By FY98, cell-agile Fastlane encryption devices will be exploited in joint service testing. The design of waveforms for communications protection will enhance capability to reject three times the number of jamming and unintentional interfering sources to ensure information transmission fidelity by FY01. The program will demonstrate advanced communications waveforms by FY02 which reduce susceptibility to jamming and detection by two orders of magnitude. This will provide the warfighter with a high degree of confidence regarding connectivity throughout all phases of battle, with no attention to different operational levels of security. It will support global logistics information and tracking of warfighter resources in real time. Global connectivity in support of modeling and simulation needs is also supported by this DTO.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603006A	247	0	0	0	0	0	0	0
0603006A	257	0.2	0.2	0.2	0	0	0	0
0602702F	4519	0.7	0.9	1.1	1.5	2.6	0	0
0602204F	7662	0.1	0.1	0	0	0	0	0
0603253F	666A	0	2.1	2.4	1.0	1.1	0	0
	Total	1.0	3.2	3.7	2.5	3.7	0	0

Note: Totals may not add due to rounding.

IS.22.01 ***Network Management.*** This DTO will provide the ability to autonomously control information resources; provide the capability to visualize current and projected status of the information system across all domains; develop network management technology to provide a robust theater-level capability in support of joint service needs; provide improved utilization of network resources through efficient, proactive management of all components of the information system; provide peer-to-peer management with existing domain managers; develop network management performance optimization algorithms capable of dynamically adapting to changes in network resources and information flow requirements; provide robust management of network infrastructure to deliver priority-ordered, graceful degradation, and service restoration after outages; develop metrics and algorithms to detect surreptitious behavior within the network and strategies to mitigate their effects; provide a system capable of managing multiple security level information systems; and develop effective planning tools to automate and assist in the design and implementation of very large networks.

By FY97, the program will demonstrate dynamic planning, monitoring, and adaptation of communication networks, incorporating automated network management of tactical internetworks into the Army's Task Force XXI; and simple network management protocol (SNMP) control of asynchronous transfer mode (ATM) ashore and SNMP control of selected radio room equipment in the Navy JMCOMS program. FY98 goals are to demonstrate standards-based network management of global ATM and internet protocol internetworks integrated into a Joint Task Force environment; and peer-to-peer interoperability between different network management systems, including commercial and allied systems. By FY99, the program will provide SNMP control of the Joint Tactical Switch System in JMCOMS and transition integrated management system prototypes developed for the DISN LES environment to a tri-service global network management facility. By FY00, the goal is to demonstrate SNMP control of ATM and provide SNMP(V)2 or common management information protocol (CMIP) reports to CJTF/NAVFOR/MARFOR in JMCOMS. In FY01, integration into various legacy systems will be complete. Technical barriers associated with this area include interoperability protocols and procedures for functioning in a heterogeneous architecture; developing machine-based algorithms for fault detection/isolation and circuit restoral; detection of and immunity to surreptitious behavior; stability under large, dynamically changing network conditions including mobile networks; and integration of multilevel security mechanisms.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602702F	4519	2.3	1.4	1.0	0	0	0	0
0603789F	2335	1.4	1.0	1.0	2.2	1.1	0	0
0603253F	3833	1.4	0.7	0	0	0	0	0
0602301E	ST-19	30.7	30.2	43.9	44.8	93.2	0	0
0603761E	CST-02	17.1	20.3	15.2	4.5	0	0	0
	Total	52.9	53.6	61.1	51.5	94.3	0	0

IS.23.01 ***Digital Warfighting Communications.*** This DTO exploits emerging commercial devices and communications technologies in support of A.02 to provide commanders and warfighters with global, seamless, nonhierarchical adaptive networks for multimedia communications in a dynamic battlefield. The major thrusts of this DTO are to (1) supplement, enhance, and in some cases replace legacy military communications systems unable to keep pace with the rapidly increasing demand for communications bandwidth and global coverage in support of force projection and split-base operations; (2) evolve an integrated communication infrastructure utilizing commercial protocols and standards to achieve global tri-service interoperability through integration of land, air, space, and sea networks into a global asynchronous transfer mode (ATM) infrastructure; and (3) continue joint ATM bandwidth-on-demand experimentation to support multimedia information requirements through a DS–3 (i.e., 44.736 Mb/s) LES connection to other service laboratories.

In FY97, the program will insert ATM switching into Army mobile subscriber equipment, develop a field demonstration version of the Air Force Secure Survivable Communications Network, and continue the Navy shipboard communications program to support joint/allied JMSOMS inter-/intra-ship multimedia requirements; during the same period, it will demonstrate direct broadcast satellite technology in joint service exercises, leading to the Global Broadcast Services (GBS). The program will also begin joint experiments with high-capacity trunk radios to support a variety of mobile subscriber services in FY97. As part of the FY97 Task Force XXII advanced warfighter exercise, GBS hardware will be deployed to support DARPA's Battlefield Awareness and Data Dissemination ACTD (DTO A.14). Tactical applications of the terrestrial personal communications system will be demonstrated in FY97 and FY98 by exploiting both commercial code-division multiple access and broadband technology for Army, Air Force, and Marine Corps applications. The program will demonstrate space crosslink technology via two maneuvering air platforms.

In FY98, the program will test a radio access point to extend ATM services to forward tactical units. By FY00, the goal is to demonstrate next-generation mobile internet protocol services connecting tactical internetworks for littoral and expeditionary warfare between Marine Corps, Navy, and Army combat net radio networks in support of DARPA's Warfighter Internet Program (see DTO A.02). In FY01, RAP and airborne platform interfaces will be demonstrated in the DARPA Warfighter Internet Program.

This initiative overcomes technical issues associated with incorporating emerging commercial standards into a battlefield environment. In addition, several technical barriers must be overcome for the tactical user to take advantage of immediate access to information related to his battlefield awareness. The design of protocols able to adapt to rapidly varying conditions of the battlespace must be addressed. This includes error detection and correction technologies that will allow low error-rate performance over high error-rate links (10–3 bit error rate). This project also addresses the ability of disadvantaged links to support multimedia information services by improving the performance of time-sensitive protocols. Metrics include increased operation range (greater than 200 km), volume of information flow (greater than 45 Mb/s), and operation with highly mobile users.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602702F	4519	7.6	7.2	4.6	7.2	8.0	0	0
0602601F	3326	0.6	0.7	0.9	1.4	1.4	0	0
0603238F	4216	2.2	0	0	0	0	0	0
0603789F	4216	0	1.4	2.4	2.6	2.8	2.8	2.9
0603253F	666A	1.6	0.7	1.6	2.2	0.5	0	0
0603401F	3784	0.3	0.3	0.3	0.4	0.5	0	0
0602782A	H92	4.4	4.7	6.0	4.9	2.0	0	0
0603006A	247	2.3	0.3	3.1	0	0	0	0
0603006A	257	9.9	7.9	4.6	0	0	0	0
0602232N		3.3	3.6	2.8	0.9	0.7	0	0
	Total	32.2	26.8	26.3	19.5	15.9	2.8	2.9

Note: Totals may not add due to rounding.

IS.24.01 ***Multimode, Multiband Information System.*** This DTO provides the warfighter with flexible, interoperable communications system architecture building blocks by jointly developing the baseline architecture and modular technology needed for an objective multiband, multimode, integrated information transmission system capable of meeting joint service requirements for future digital radio and integrated avionics suites.

In FY97, a six-waveform demonstration will be performed as part of the Task Force XXI Advanced Warfighter Exercise. In FY98, the Army will conduct a command and control vehicle demonstration to illustrate Speakeasy application to difficult cosite platforms. Included are legacy waveforms such as single-channel ground and Airborne Radio System/System Improvement Program, ultrahigh frequency satellite communications, demand-assignment multiple access, Enhanced Position Location Reporting System, very high speed integrated circuit, Have Quick I and II, and improved high-frequency radio, as well as high data-rate packet waveforms required by future digitized battlefield architectures and commercial waveforms such as Global Positioning System and cellular radio. The core radio requirements specify 2–2,000-MHz operation. Integrated avionics efforts focus on thermal management and packaging required for airborne applications. This initiative will ameliorate radio interoperability problems providing the warfighter with the capability to interconnect existing, diverse, and incompatible systems. A significant reduction in the logistics tail, which would be required to support multiple radio systems for multiple applications, is achieved. Technical barriers include the development of high-speed digital signal processors (DSPs), multiband antenna, and an industry/DoD joint radio architecture. By FY99, 17 waveforms in the 2–2,000-MHz band, including network protocols and security, will be demonstrated. Technology insertion includes the use of advanced DSPs; a programmable, cryptographic reduced instruction set, processor-based INFOSEC module; and new interference cancellation circuitry. By FY01, the program will demonstrate the ability to reduce the size, weight, power, and cosite interference problems that occur when multiple radios in the same or dissimilar radio bands are integrated within a single system; and demonstrate reduced radio frequency filtering and band switching to reduce front-end losses and allow extended range or reduced transmit power levels.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602702F	4519	1.3	1.4	2.5	1.0	1.9	0	0
0602204F	7662	0.7	2.1	2.2	2.3	2.4	0	0
0602601F	8809	0.3	0.4	0.3	0	0	0	0
0603789F	2335	2.2	3.1	2.3	1.5	2.8	0	0
0603253F	3833	1.8	1.0	1.0	3.0	2.5	0	0
0603006A	247	2.6	2.9	3.3	4.0	3.3	0	0
0603760E	CCC-01	6.1	0	0	0	0	0	0
	Total	15.0	10.9	11.6	11.8	12.9	0	0

IS.28.02 ***Intelligent Information Technology.*** This DTO will develop technology to enable a new level of capability to search, query, monitor, and update large collections of changing, potentially inconsistent, heterogeneous data sources. Data sources include knowledge bases, structured databases, semi-structured documents, and unstructured text and image files. The goal is to reduce by a factor of 10 the time required to construct and validate large knowledge-base (KB) systems. KB systems provide comprehensive coverage of selected domains, are maintainable in a rapidly changing environment, and are reusable by a variety of applications using diverse problem-solving strategies. This DTO will enable a new class of intelligent battlefield systems by producing technology to build large-scale knowledge bases quickly and economically. It will provide the technology to transform dispersed collections of heterogeneous data sources into virtual knowledge bases to support C^4I requirements in joint actions involving battlefield situation assessment, telemedicine, and intelligence fusion.

By FY98, the program will demonstrate 100–125% improvement in environments to search, retrieve, cooperatively query, monitor, and update multiple-mediator systems; and develop reusable libraries of primitive KB components and tools to reduce development time from years to months. FY99 goals are to demonstrate a 50% improvement in data/knowledge and to demonstrate large collections of large-scale information associates, including increasing KB magnitude by developing knowledge acquisition tools. These improvements will be demonstrated for C^2, logistics, and battlefield awareness, and will assist the warfighter in meeting requirements for information warfare and joint precision strikes. By FY00, the program will demonstrate an increase in the level of integration complexity (greater than 50%), enabling the integration of information sources with different data structures, data schemata, data semantics, and data inconsistencies; demonstrate a ten times productivity improvement by combining the above capabilities with the development of problem-solving methods and techniques. Demonstrations are planned for BADD, ALP, the Joint Force Air Component Command project, the Dynamic Multi-User Information Fusion Program, and the GENOA program for crisis understanding and mitigation. By FY02–03, virtual reality will enable advanced information retrieval and integration tools to achieve substantial increases in the number of data sources which can be integrated.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602783A	Y-10	1.0	1.1	0	0	0	0	0
0602301E	ST-11	31.1	35.6	79.3	97.3	122.0	138.0	142.0
0602301E	ST-19	4.9	0	0	0	0	0	0
0602702F	5581	1.2	1.4	1.6	1.7	1.9	2.0	2.1
0603728F	2532	0.3	0.3	0.3	0.6	0.5	0.5	0.5
	Total	38.5	38.3	81.3	99.6	124.4	140.5	144.6

Note: Totals may not add due to rounding.

IS.29.02 ***Software Technology for High-Performance Computing***. This DTO will develop and demonstrate software tools to develop and transition mission-critical software to new applications of high-performance computers to computer-bound problems in mission rehearsal, ATR, decision aids and modeling and simulation for command and control.

Currently, sequential computers have theoretical limits on computational throughput. High-performance computers (including biological, quantum, and cellular) have no theoretical limit. Current limitations on cost, power, size, and weight are overcome through the use of high-performance computers. High-performance computing power is available at the desktop and, potentially, on the battlefield; however, these machines encompass a wide variety of differing architectures, and software tools and methodologies required to harness the full power of these machines have been sorely lacking. By organizing these technology developments into scaleable software libraries, high-performance languages and runtime services, distributed high-performance computing resources can solve large-scale problems through data and task parallelization. Applications such as satellite image data processing, battle damage assessment, multisensor and information fusion, and automated cooperation among multiple intelligent agents are prime candidates for high-performance computers. These machines also produce more efficient and optimized algorithms for robust, adaptive network communications. By parallelizing and optimizing engineering codes and by capturing and setting up system design knowledge bases and automated resynthesis, system design times can be significantly reduced, leading to end-user field modifiable systems.

In FY99, the program will demonstrate an intelligent, optimizing platform independent compiler with a fivefold to tenfold code improvement over 1995 baselines. In FY00, the goal is to predict response-time performance throughout the design and coding phases for real-time and information processing HPC applications to within 98% of actual performance. During FY02–FY03, the program will demonstrate high-performance computer software engineering environments for reducing parallel software development costs by 75% over 1994 baselines. This capability will facilitate future intelligence, surveillance, and reconnaissance warfighter missions predicted for the battlefield of the twenty-first century.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602301E	ST-19	19.2	15.9	14.9	32.9	0	0	0
0602301E	ST-24	0.7	0	0	0	0	0	0
0602702F	5581	9.3	9.8	10.4	10.4	10.4	10.7	11.0
0603728F	2527	1.0	1.1	0.6	1.1	1.2	1.2	1.2
0602783A	DY10	1.0	1.1	0	0	0	0	0
0602301E	ST11	15.3	17.0	14.0	7.0	0	0	0
0602301E	ST22	18.1	19.6	20.2	20.8	21.4	21.4	21.4
0603728F	2532	1.0	1.0	1.2	0.8	0.8	0.9	0.9
0602234N		9.3	11.8	12.4	12.9	13.3	13.7	14.3
	Total	74.9	77.3	73.7	86.0	47.1	47.8	48.8

Note: Totals may not add due to rounding.

IS.30.02 ***Advanced Embedded Software/System Engineering Technology***. The goal of this DTO is to develop, demonstrate, and transition state-of-the-art applications-specific software architecture and computer-based software/system engineering technology to address the $30 billion annual DoD expenditure on embedded software-intensive systems. This will be accomplished by integrating COTS software, software reuse, new tools and environments, and process and technology, thereby significantly improving development and re-engineering productivity and product quality for legacy and embedded systems.

By FY97, the program will demonstrate the potential to reduce system engineering efforts by 40% by incorporating object-oriented technology; and demonstrate multiview design capture schema for multidisciplinary requirements. FY98 goals are to demonstrate the potential to automatically incorporate extra-functional requirements, such as fault-tolerance and security, into mission-critical software; demonstrate the ability to statically evolve system implementation by replacing selected components with components of enhanced capabilities; and support formal investigation of safety, security, and fault tolerance aspects of an architecture. The overall goal is to reduce the manpower and elapsed time to perform these activities over FY95 norms by 50% and 80%, respectively. The program will demonstrate a multicriteria design optimization capability and a C^4I software integration infrastructure. By FY99, the plan is to demonstrate the ability to use applications software architectural specifications to reconfigure executing applications in response to changes in the operating environment, reducing required manpower by at least 90%; and to develop human-centered system design processes and methods. By FY00, the program will demonstrate the ability to perform field-adaptable changes to incorporate new warfighting capabilities or interoperability requirements; and demonstrate the ability to use architecture specifications to encapsulate interface and protocol requirements. The FY01 goal is to demonstrate the potential of human-centered design technology to reduce life-cycle costs of complex systems. During FY02–03, the program will demonstrate the potential of knowledge-based technology to reduce total life-cycle costs of software-intensive embedded weapons software by 90% over the FY95 baseline; and demonstrate the ability to perform architectural transformations, reducing software porting costs by 90–95%. This effort relates to DTO IS.28.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602783A	Y-10	1.0	1.1	0	0	0	0	0
0602301E	ST-11	13.5	17.0	14.0	7.0	0	0	0
0602301E	ST-22	16.5	19.6	20.2	20.8	21.4	21.4	21.4
0602702F	5581	3.5	3.4	4.1	4.1	3.7	3.9	4.0
0603728F	2532	1.0	1.0	1.2	0.8	0.8	0.9	0.9
0603728F	2527	1.4	1.2	1.7	1.3	1.3	1.4	1.4
0602234N		4.7	5.8	6.0	6.1	6.3	6.4	6.6
	Total	41.6	49.2	47.1	40.1	33.6	33.9	34.3

Note: Totals may not add due to rounding.

IS.31.02 ***Intelligent Control.*** The focus of this DTO is on automated learning and reasoning techniques for autonomous systems and intelligent aids for human decision making. The current mode of intelligent control is expensive and tedious because it involves manual software engineering. Labor-intensive parameter adjustments are needed to address complex subsystems and environmental relationships. Additionally, control decisions are too slow for real-time performance. Mechanisms currently available to cope with sensor and actuator failures are too primitive to adapt to unexpected events. Integrating a variety of machine-learning techniques is highly complex. Demonstrations will be conducted using artificial intelligence methods for creating and testing candidate control logic for autonomous and semiautonomous devices. Other methods will be pursued that can utilize emerging simulations of devices and their environments and are extendible to acquisition of control logic in support of single devices, as well as multiple-device systems where coordinated behavior is required. Demonstrations of control logic acquisition and testing will be conducted with simulated applications of undersea, ground, and air vehicles engaged in tactical combat and strategic maneuvering. Real-time control is supported by data from innovative vision subsystems.

In FY97, the program will demonstrate the application of machine-learning techniques to robotics software development and control on area mapping tasks; demonstrate learning of tactics for coordinated behavior by multiple mobile robots on a simplified surveillance task; and implement and test learning methods in environments in which other agents are also learning. In FY98–02, the plan is to demonstrate learning of tactics for coordinated behavior by multiple robots on complex surveillance tasks, and distribute to service laboratories advanced tools integrating machine learning methods. This DTO contributes to the JWSTP Information Superiority area by providing tools to create software for controlling mobile surveillance and reconnaissance platforms, and to Precision Force by providing tools for the adaptive testing of guidance and control software in weapon delivery systems. Success in meeting these objectives will be measured via a sequence of experiments with mobile robots which incorporate machine learning algorithms. The metrics to measure success include scalability, or support for multiple levels of behaviors/tasks, adapting to environmental changes, and adapting to internal changes; efficiency in learning and performance; stability (convergence or oscillations to a set of behaviors); communication (amount/frequency required to perform cooperative tasks); and robustness.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		1.6	2.1	2.3	2.6	2.8	3.0	3.3
	Total	1.6	2.1	2.3	2.6	2.8	3.0	3.3

IS.32.02 ***Information Presentation and Interaction***. The goal is to develop and demonstrate advanced concepts to allow warfighter interaction with a global information system in a naturally expressive, timely, and flexible manner. Activities include infrastructure support for collaborative decision making and battle damage assessment; interactive faster-than-real-time war gaming; warfare assessment; battlefield data fusion; synthetic visualization for mission scheduling, planning and rehearsal, simulation, and training; enhanced battlefield situational awareness using presentation technology for stereoscopic three-dimensional viewing; and more natural modes of system interaction such as speech and gestures.

By FY97, the program will demonstrate a very high resolution (6 million pixels) group data wall with spoken input and an electronic grease pencil interface; and demonstrate the spectrum of virtual worlds applications (immersive, nonimmersive, and augmented) for mission planning and rehearsal. The FY98 goal is to demonstrate a 15-million pixel data wall supporting the simultaneous interaction of multiple collocated users. By FY00, the program will incorporate gesture interpretation with spoken input as synergistic C^4I interface. This initiative attempts to overcome the inherent limitations of current command and control systems and offer the warfighter major improvements in the ability to see, understand, and interact, in real time, with critical worldwide information. It is anticipated that situational awareness will improve by 50% and dynamic war planning/replanning activity will occur in 50% of current time lines. This DTO supports DTOs IS.01, IS.02, and IS.03.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602301E	ST-11	11.4	17.0	2.0	1.0	0	0	0
0602301E	ST-19	21.8	27.4	48.3	43.8	20.0	0	0
0602702F	5581	1.4	1.4	1.6	2.2	2.5	2.6	2.7
0603728F	2530	0.2	0.1	0.2	0.7	0.8	0.8	0.8
0603728F	2532	0.3	0.1	0	0	0	0	0
0602234N		0.6	0.6	0.6	0.6	0.6	0.6	0.6
0603761E	CST-02	0.3	0	0	0	0	0	0
	Total	36.1	46.6	52.6	48.3	23.8	4.0	4.1

Note: Totals may not add due to rounding.

IS.33.02 ***Embedded High-Performance Computing.*** The goal is to provide timely, affordable, and easily upgradable technology to meet the high-speed computational demands of the military by leveraging and influencing the efforts of the commercial sector. This DTO will provide the technology for improving ATR from air, space, ground, and sea vehicles and weapons, and improving other high-computation tasks such as sensor/data/knowledge fusion for situational awareness. The objective is to develop innovative computational models, methods, and mechanisms which explore the limits of nontraditional computing; to define models of computation for nontraditional approaches and potential elemental computational mechanisms; and to validate these mechanisms through experimentation. The intent is to model, prototype, and characterize nontraditional computing approaches to explore the limits of deep submission silicon-based technology and predict the behavior and limits of new computational modalities.

By FY97, the program will demonstrate a capability for 100 GFLOPS/ft^3 for militarized high-performance computing. By FY98, the program will demonstrate 10% less memory usage, 10% performance improvement, and a five times improvement in rest time. The goal is to accomplish adaptive load balancing by FY99, and, by FY00, demonstrate a TFLOPS scaleable system with a hard-real-time secure operating system and middleware. Also by FY00, the program will demonstrate a high-performance architecture independent software/system engineering suite for achieving 50% overall efficiency on massively parallel computers.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602301E	ST-19	72.6	71.6	66.7	49.0	65.9	0	0
0602301E	ST-24	4.1	2.5	0.3	0	0	0	0
0602712E	MPT-02	8.4	0	0	0	0	0	0
0603761E	CST-02	0.5	0	0	0	0	0	0
	Total	85.6	74.1	67.0	49.0	65.9	0	0

IS.34.01 ***Joint Force Air Component Command Battle Management Program.*** This DTO will develop, integrate, and demonstrate system architecture and planning technologies enabling revolutionary air campaign planning processes, which will significantly enhance a Joint Force Air Component Command (JFACC) ability to plan and execute an air campaign at any level of crisis. The JFACC program will transform air operations planning capabilities from a reactive, sequential system to one providing continuous, near-real-time predictive planning, and rapid response to dynamic situations. A robust planning capability enabling rapid evaluation of alternatives, less human-intensive planning processes, and feedback on campaign accomplishment will be realized. A JFACC planning and execution system will be developed that can be tailored to theater needs with significant reach-back. The JFACC program will provide a system architecture to support a range of operational concepts, including coordinated decentralized execution of operations. This DTO will use planning technology and infrastructure developed under other DTOs (IS.02 and A.37), and will provide technology input into the Advanced Joint Planning ACTD (F.02).

By FY97, the program will demonstrate a tailorable information architecture to support an integrated, collaborative planning tool set; demonstrate a prototype intelligence, surveillance, reconnaissance, and logistics planner; demonstrate a prototype target system analysis capability, collaborative support for integrated planning, and use of a comprehensive priority/value-derived decision support structure based on the strategy-to-task paradigm; and utilize map-based static and dynamic visualization for plan development and assessment. By FY98, the program will demonstrate integrated strategy development using objective-to-task-to-activity planning agents, integrated campaign assessment relating objectives to tasks and measures of merit (MOMs), and support for spontaneous virtual planning groups including data sharing, replication, and consistency management. The FY99 goal is to demonstrate continuous integrated planning including agents, situation triggers, and adversary models; dynamic continuous campaign assessment with automatic update of status of plan satisfaction; and seamless, reconfigurable collaborative planning to support multiple tasks. By FY00–01, the program will demonstrate the ability to rapidly generate and evaluate course of action and develop an integrated strategy which establishes tasks and MOMs for force application, force enhancement, force support, and aerospace control.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603760E	CCC-01	13.1	32.7	37.1	24.4	20.0	0	0
0602702F	5581	0.2	0.4	0.4	0.9	0.4	0	0
0603782F	2530	0	0.6	1.0	1.3	1.5	0	0
	Total	13.3	33.7	38.5	26.6	21.9	0	0

IS.38.01 ***Antenna Technologies.*** The goal of this DTO is to develop and demonstrate affordable antennas to support on-the-move operations to a variety of platforms. These antennas will improve performance (e.g., link availability, bandwidth), service multiple functions, and reduce weight, volume, and signature profiles (e.g., infrared, RCS, visual). The primary technologies that will be developed to achieve this objective include structurally integrated wideband antennas (bandwidth versus impedance match versus radiation pattern), multifunction signal distribution architectures (dynamic range versus bandwidth versus power handling), and electronics for cosite electromagnetic (EM) interference mitigation (isolation versus settling time versus bandwidth). Principal demonstrations include (1) high data rate, ultra high frequency transmit/receive architecture as part of the Multifunction Electromagnetic Radiating System (MERS) ATD in FY97 (this architecture will enable multiple radios to utilize a single antenna with a factor of 100 improvement in bandwidth); (2) broadband high-power cosite interference cancellation as part of the MERS ATD and the Army Speakeasy command and control vehicle demonstration in FY98 (this will enable a reduction of cosite EM interference from 10 to 60 dB in less than 100 microseconds); (3) photonically reconfigurable multifunction CNI antenna as part of the Navy/Army SERAT demonstration in FY98 (this conformal antenna technology will enable a single antenna structure to service three unique CNI functions reducing the number of antennas by a factor of 3); (4) wideband antenna technology for Speakeasy applications (this will reduce the number of required antennas); (5) structure-tuned, optically switched reconfigurable antenna technology (in FY98); (6) affordable one-dimensional, multifunction SATCOM phased array as part of the Navy Submarine Communications ATD in FY98 (this will enable multiple SATCOM signal beams to be transmitted/received simultaneously via one-dimensional phased array steering that will significantly reduce the array cost); (7) shipboard test of the MERS ATD, validating performance of affordable, structurally integrated, multifunction antenna system servicing at least four disparate communications systems in FY99 (this technology will enable a reduction by a factor of 3 in the number of antennas located topside on the next-generation surface combatant; (8) OTM, self-steering antenna capability for SHF and EHF land-based SATCOM terminals in FY00 and FY01, respectively (this technology will enhance link availability for land-based SATCOM); (9) OTM wideband (45 Mb/s at X-band), triple beam, phased array antenna technology with full duplex operation demonstration as part of the DBC ATD (part of IS.23) in FY99 (this technology will allow high-capacity, OTM RAP operation with multiple simultaneous transmissions in mobile environments); and (9) an integrated photonic subsystem in FY00 (this will demonstrate photonic control of a multipanel, phased array antenna to significantly reduce the size, weight, cost, and power requirements while at the same time increase performance).

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602702F	4519	0.4	0.6	1.7	1.2	0	1.1	1.1
0602702F	4600	0.4	0.2	0	0	0	0	0
0602782A	H92	1.5	2.0	2.1	2.1	2.3	0	0
0603430F	4056	2.3	0.3	0	0	0	0	0
0603006A	247	1.6	2.7	2.3	1.5	0	0	0
0603006A	257	0.4	0.2	0.2	0.1	0	0	0
0602232N		4.1	3.9	1.6	0	0	0	0
0603792N	R1889	4.0	6.4	4.5	0	0	0	0
	Total	14.7	16.3	12.4	4.9	2.3	1.1	1.1

IS.40.01 ***Individual Combatant and Small-Unit Operations Simulation.*** This DTO will develop a high-level, architecture-compliant individual combatant simulation system across the Research, Development and Acquisition (RDA), Advanced Concepts and Requirements (ACR) and Training Exercises and Military Operations (TEMO) domains. Technical barriers include human representation and visualization of individuals and weapon states, human performance modeling, human system interfaces that are unencumbered and elicit realistic performance, networked simulations for interoperability with other dissimilar simulations, computer-generated forces that contain realistic individual and unit-level behaviors with C^3I representation, synthetic terrain with relevant resolution/fidelity to allow operations in a tactically correct manner, and instrumentation for high-precision engagement simulation to allow for data capture and analysis.

By FY98, the program will refine RDA, ACR, and TEMO simulation requirements, and create a multisensory, real-time networked simulation of the battlefield that immerses the individual combatant in three-dimensional geographical space using virtual reality technologies.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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LTC Walter Hamm MARCORSYSCOM (703) 784-4790		COL Pentecost USAIS-DOT (706) 545-5717	

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602308A	C90	1.8	1.4	0	0	0	0	0
0602716A	H70	0.8	0.8	0	0	0	0	0
0602618A	H80	0.7	0.7	0	0	0	0	0
	Total	3.3	2.9	0	0	0	0	0

IS.46.01 ***Advanced Logistics Program.*** This DTO develops technology which will be demonstrated through DTO F.14, Joint Decision Support Tools (Joint Logistics ACTD, Phase II), and F.15, Real-Time Focused Logistics (Joint Logistics ACTD, Phase III). The Advanced Logistics Program (ALP) will produce information technology to put the right materiel in the right place at the right time, while supporting the need to do so with reduced reliance on large DoD inventories. ALP will develop a shared technology base of information manipulation and planning tools to support planning, execution, monitoring, and focused replanning throughout the logistics pipeline. This will be demonstrated through a system that couples continuous planning and execution monitoring in an interoperable course of action (COA) and logistics support environment linking CINC operations and logistics staff, DLA, and TRANSCOM. The program will focus on four main areas: transportation tools to track assets and make smarter use of lift; rapid supply services for faster and more flexible acquisition of supplies; force sustainment planning and sourcing; and logistics COA feasibility planning linked to the war plan.

During FY96–97 (Phase I), ALP will develop and demonstrate data gathering tools to include semiautonomous capture, search, and retrieval of data in disparate defense and commercial logistics sources. Servers for transportation, sustainment, and rapid supply services will be developed, upon which integrated applications to support planning, direct scheduling, and execution will be run. This architecture will provide collaborative visualization and a decision support environment for force deployment. This DTO also will develop automated supply and sustainment source locating and purchasing tools and demonstrate coarse-grained COA. During FY98–99 (Phase II), the ALP will demonstrate an integrated environment to support the planning, execution, and monitoring of a major force deployment, including optimized scheduling and routing with zero staging throughout the move. The collaborative decision environment will be expanded for in-theater units, DLA, and service logistics commands. An automated dynamic critical items list will be developed as an integral part of sustainment planning and execution. ALP will develop and demonstrate the ability to rapidly negotiate between suppliers and buyers, through information exchange, including rapid flexible team and item relationship catalogs. Significant research will develop deviation detection sentinels and predictive analysis tools and demonstrate a medium-grained COA evaluation. During FY00 (Phase III), ALP will develop and demonstrate a complete end-to-end advanced logistics system for the planning, execution, monitoring, and rapid replanning of a major force deployment from CONUS to in-theater final destination, including dependency-driver notification for reactive replanning, a logistics annex for the OPLAN, and a fine-grained COA evaluation.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603712S	DLA	12.9	12.9	12.9	12.9	12.8	12.6	0
0602702E	TT-10	18.3	25.7	27.7	10.6	10.0	0	0
	Total	31.2	38.6	40.6	23.5	22.8	12.6	0

GROUND AND SEA VEHICLES

GROUND AND SEA VEHICLES

GV.01.06 ***Future Scout and Cavalry System.*** By FY02, the goal is to demonstrate through virtual prototyping, demonstrator hardware testing, and user field experimentation the feasibility and operational potential of a lightweight scout vehicle chassis integrating DoD-wide scout-specific technologies that yield a 500% increase in target detection rate, 20% increase in cross-country speed, 25% reduction in time required to create and send a spot report, and 30% improvement in operations on the move relative to the M3A3 Bradley Cavalry Fighting Vehicle that is currently in production. These technologies include scout sensor suite, advanced crew-stations, commercially based open systems electronic architecture, advanced command and control, advanced survivability systems, electric drive—leveraging DARPA's Hybrid Electric Power Program—semiactive suspension, lightweight track, advanced lightweight structural materials and armors, and medium caliber weapon. The FSCS Integrated Concept Team, lead by the U.S. Army Armor Center with participation by the AMC and PEO Armored Systems Modernization, is currently developing vehicle requirements, technology assessments, and program plans. The FSCS will employ virtual prototyping and integrated product teams to reduce timelines and optimize performance capabilities. The FSCS ATD is the centerpiece for technology transition to development that will provide the potential for streamlined acquisition through the Fast Track approach.

In FY97, crewstations optimized for the FSCS mission and digitized battlefield will be designed, and panoramic displays, multifunction displays, and head-mounted displays will be developed for the crewstations. In FY98, crewstation simulators will be built to test, improve, and validate the crewstation designs; transition the virtual prototype developed from concepts; and competitively award the ATD contract to industry. In FY99, preliminary designs will be developed from the virtual prototype; alternatives explored, a vehicle-level System Integration Laboratory initiated; and scout mobility and survivability technologies demonstrated in user warfighting experiments. In FY00, subsystems fabrication will be completed, and demonstrator fabrication and integration will be performed. In FY02, a technical test and BLWE will be completed. Key demonstrations include: FY97—Hunter Sensor Suite ATD and Hit Avoidance ATD; FY98—Composite Armored Vehicle ATD and Target Acquisition ATD; FY01—Multifunction Staring Sensor Suite ATD.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602618A	AH80	0.3	0.1	0	0	0	0	0
0602601A	AH91	2.6	2.0	2.4	0	0	0	0
0602705A	AH94	0.7	0	0	0	0	0	0
0602716A	AH70	0.8	0.8	0	0	0	0	0
0603005A	D440	0	1.3	20.4	34.3	37.9	6.0	0
0603005A	D497	1.7	1.8	0	0	0	0	0
0603226E	EE48	2.0	1.0	0.5	0	0	0	0
	Total	8.1	7.0	23.3	34.3	37.9	6.0	0

GV.02.06 ***Future Combat System.*** FCS technology integration efforts will focus on achieving leap-ahead capabilities for a ground-combat vehicle weapons platform in the areas of mobility, lethality, survivability, deployability, fightability, and sustainability. Specific goals are: by FY01, downselect to a lethality launcher subsystem with a 50% increase in engagement range and probability of kill, given a hit of 1.0 with a loss exchange ratio of 80% against all large caliber threats, develop alternative material and structures, and integrate crew functions to achieve a 33% weight savings over baseline (70-ton) and 25% reduction in crew; by FY03, advance the enabling electric drive technologies for a ground propulsion system that will increase cross-country speed by 40% while reducing consumables by 20% over the current baseline; by FY04, develop digital open weapons systems architectures and advanced Vetronics to reduce crew workload by 50%; by FY05, complete FCS advance smart armor, armor structures, and active protection systems; integrate, demonstrate, and evaluate the synergy of subsystem components on a system demonstrator, advance embedded diagnostic, and prognostic capabilities to provide increased reliability and maintainability by 10%.

The payoffs for implementing these technologies include the ability and flexibility to defeat line-of-sight targets out to 5 km, and non-line-of-sight targets to 10 km for any known threat system to the year 2025 and beyond; achieving a level cross-country speed of 100 km/hr; achieving vehicle and crew protection against direct fire KE/CE munitions and hemispheric protection against indirect threats; and reduction of vehicle weight by 33%, of consumables such as ammunition and fuel by 50%, and of crews by 25%.

The technology barriers are the specific power, specific energy, and efficiency that key components need to attain to be integratable within the constraints of the combat vehicle. Mobility barriers are the volumes of the engine, active suspension and transmission components, high specific power demands, volume and weight of electrical energy storage components, and efficiency of electric power conditioning devices. The stability of the power management and distribution system is also a barrier in the integration of electric armament lethality systems. The integration advanced armors, active protection systems, and signature management, is also impeded by the volume and weight of the electrical energy storage and power conditioning component. The energy level of ammunition propellants is an additional barrier to survivability integration. Information management, vehicle maintenance, and driveability using external sensors are key barriers in achieving fightability goals with a reduced crew.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601A	AH91	0	0	0	5.2	5.2	5.8	5.9
0603005A	D440	0	0	0	0	0.6	17.4	31.3
0603764E*	LNW-01	10.7	24.0	22.9	10.0	10.0	0	0
	Total	10.7	24.0	22.9	15.2	15.8	23.2	37.2

*DARPA funding is directed at combat vehicle mobility and survivability technologies. These technologies are applicable but not specific to the FCS.

GV.03.00 ***Ground Vehicle Electronic Systems.*** The primary goal is to reduce the manning requirements to operate and support ground vehicles. Specific goals include reduction of task execution timelines by 25% in FY00 and 50% in FY02; reduction in cost per source-line of code by 30% in FY00 and 50% in FY02; increase in system performance by fivefold in FY00 and tenfold in FY02; and reduction in cost ratio of electronic/software upgrades by 50% in FY02. The program will be conducted in three phases and will leverage the FSCS ATD to accomplish its goals. The first phase will be conducted to provide input to the FSCS ATD at contract award. The second phase will be conducted under the FSCS ATD and will culminate in a simulated integration lab demonstration. The third phase will harmonize competing ATD approaches and provide demonstration of the goals to be inserted into the FSCS EMD. The program, if successfully executed, will itself be a demonstration of an open systems approach.

Ground vehicle payoffs from the integration of advanced vehicle electronic architecture and crewstation include improved deployability of smaller combat vehicles resulting from reduction of number of crew members, the ability for the combat vehicle crew to handle massive amounts of new digital information being generated on the future battlefields, reduced operating and support costs of electronic systems, and reduced cost and time to integrate upgraded and modular subsystems.

New Army doctrine requires soldiers to fight and win the information war. Ground combat vehicle crews are required to operate in a constrained, time-critical, event-intensive, and information-limited environment which results in sub-optimum mission task executions. Technology barriers that prevent optimum crew performance are the lack of data and hardware automation technologies, lack of SMI technology that aids the crew in assimilating cognitive information, lack of well-defined and structured knowledge base for decision aiding, lack of algorithms to dynamically balance crew workload, and lack of design schema for user-tailorable and -reconfigurable SMI. Embedded computer-based weapon systems are complex, hardware-intensive, real-time distributed systems. The need to meet hard, real-time task deadlines to avoid catastrophic consequences and the lack of generalized and commercial real-time technology have resulted in system stovepiped and unique technology implementations which have become increasingly unaffordable, prone to obsolescence, and difficult to maintain and upgrade. The general approach is (1) to define a comprehensive and real-time yet generalized and evolvable computer/network/software interface structure that can optimize commercial-off-the-shelf (COTS) applications and enable standard and reusable technology solutions, and (2) to develop required non-COTS reusable technology solutions while continuing to advance the system processing and network throughput.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601A	AH91	1.5	1.1	0	2.0	2.0	2.2	2.3
0602716A	AH70	0.4	0.4	0.4	0	0	0	0
0603005A	D497	1.0	1.4	7.4	8.6	9.5	6.5	6.5
	Total	2.9	2.9	7.8	10.6	11.5	8.7	8.8

GV.04.00 ***Advanced Ground Vehicle Mobility Systems.*** Goals for this DTO include (1) increasing propulsion power density to 8.0 hp (sprocket)/ft^3 (the M1 has a propulsion power density of 3.3 hp (sprocket)/ft^3 and AIPS has a propulsion power density of 6.6 hp (sprocket)/ft^3); (2) decreasing track weight 40%; (3) increasing cross-country speed at 2-inch rms 60%; (4) semiautonomous control to traverse dangerous environments; (5) high-performance off-road 4x4s for reconnaissance/scout missions; (6) electric drive (coordinated with DARPA); (7) improved water performance of amphibious vehicles; (8) high-power engines for AAAV; and (9) corrosion prevention. This DTO coordinates TARDEC, DARPA, USMC, and ARL mobility technology programs to achieve the above goals. Specific milestones are: in FY97, demonstrating selected advanced mobility components and technologies, including advanced motor and generator configurations for electric drive, advanced high-power controller packaging, and adaptive suspension damping (tracked vehicle); in FY97, completing a Future Combat System (FCS) diesel engine and propulsion system volume reduction study; in FY98, demonstrating an active track retention system; in FY99, completing evaluation of a single-unit electric suspension actuator in the laboratory; by FY00, developing preview sensors for fully active suspension and demonstrating tactical operations employing highly agile, robust semiautonomous ground vehicles; and by FY01, demonstrating SiC power electronics in the laboratory.

Mobility technology advances will provide compact power necessary to achieve a smaller and lighter FCS in the 40–50-ton range, facilitate the power requirements of electric weapon options, and provide cross-country mobility increases for speeds up to 60 mph over selected terrain.

For FCS to be an electric drive, power electronics must be developed that are capable of handling the power requirements of a large combat vehicle without overheating. A continuous-band track must be developed to move beyond lightweight applications into the medium-to-heavyweight vehicles. For active suspension, sensors and algorithms must be developed that can preview rough terrain and react accordingly. Suspension reaction units must be developed which can provide the response required and yet be practical in terms of size, weight, and power consumption. For FCS application, a low-heat-rejection engine must be developed that has improved power density

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602131M		2.8	3.4	3.8	3.7	3.5	3.5	3.5
0603747N	EVO1	13.0	0	0	0	0	0	0
0602601A	AH91	0.4	1.7	2.9	5.4	6.2	5.7	5.7
0603005A	D441	4.2	3.8	4.8	3.4	4.7	10.6	12.7
0603005A	D497	0	0	0	0	0	4.3	6.5
0603640M	C2223	2.5	3.9	5.0	8.0	9.0	9.0	9.0
0603764E	LNW-01	0	5.0	8.5	8.0	7.0	4.0	0
	Total	22.9	17.8	25.0	28.5	30.4	37.1	37.4

GV.05.00 ***Ground Vehicle Chassis and Turret Technologies***. This DTO will demonstrate a 30% reduction in vehicle structural and armor weight through the use of lightweight materials such as composites for structural and armor applications in ground combat vehicles as an integrated system with signature technologies incorporated. The goal is to complete fabrication and assembly of the Composite Armored Vehicle ATD in FY97. By FY98, the program will demonstrate the feasibility of a composite structure and advanced armor solution for a 22-ton, air-transportable vehicle weighing at least 33% less than an aluminum-based structure and armor of equal protection level. Concurrently, the program will demonstrate manufacturability, repairability, durability, and large section cutouts/joining of composites as well as integration of signature management; and assess the affordability of composite structures for ground combat vehicle applications.

The payoffs for achieving these capabilities include a reduction in gross vehicle weight of 10–15% for vehicles in the 15- to 30-ton range, reduction of structural and piece-part weight in larger and smaller vehicles, and an integrated solution with structure, armor, and signature management combined.

The technical barriers for chassis and turret technologies are in manufacturing. The properties of the materials are fairly well known, but the ability to manufacture combat vehicles from these materials needs more work than was done under the Composite Armored Vehicle Program. A strong ManTech effort is needed to capitalize on CAV knowledge.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602131M		0.1	0	0	0	0	0	0
0602618A	AH80	0.6	0.6	0	0	0	0	0
0603005A	D440	13.5	1.5	0	0	0	0	0
	Total	14.2	2.1	0	0	0	0	0

GV.06.02 ***Surface Ship Integrated Topside Concepts.*** The objective is to develop and demonstrate surface ship topside concepts having reduced signatures (specific signature levels are classified) to permit achievement of SC–21 (and other future combatants) signature goals; controlled electromagnetic emissions; and improved sensor performance (e.g., eliminating antenna blockage; permitting reliable, automatic operation of topside antennas). Technical base efforts in the areas of lightweight structures, RCS and IR signature prediction/control, and electromagnetic compatibility provide the foundation for innovative improvements in topside design configurations. Four ATDs (Advanced Enclosed Mast/Sensor System, Multifunction Electromagnetic Radiating System, Littoral Warfare Real-Time EMI Frequency Management, and Low-Observable Multifunction Stack) will provide the risk reduction required prior to incorporating these concepts in ship acquisition programs. Major milestones toward achieving the objective are, by FY00, ship topside concepts that combine shaping, arrangements, antenna concepts, and other control techniques to obtain balanced and greatly reduced RCS/IR signatures; at-sea demonstration of an enclosed mast/sensor that reduces RCS signature and improves sensor performance; at-sea demonstration of a low-signature, multifunctional communication system fully integrated into a composite structure; at-sea demonstration of a wideband (2 MHz to 50 GHz) electromagnetic emission control system; and an at-sea demonstration of a low RCS/IR signature stack concept with fully integrated SATCOM antennas.

Potential payoffs relative to the notional Flight IIA upgrade to the DDG–51-class destroyers will be a 90% reduction in topside RCS/IR signatures and a 99% reduction in topside electromagnetic interference/emissions by the year FY00.

The major technical barriers to achieving the objective are reliable high-quality, low-cost composite structures for enclosing and embedding antennas; frequency-selective surfaces/panels to achieve acceptable antenna performance while reducing RCS signatures; reliable methods to predict RCS/IR signatures of complex topside configurations taking into account secondary effects; multifunction communication antennas fully embedded in lightweight structures; IR coating materials having long life in a marine environment; and a wideband electromagnetic monitoring system.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602121N		5.6	5.4	5.0	2.4	2.4	2.4	2.4
0603792N	R1889	11.9	12.0	9.0	4.0	0	0	0
Total		17.5	17.4	14.0	6.4	2.4	2.4	2.4

GV.07.02 ***Surface Ship Advanced Electrical Power System.*** This DTO develops the technical basis for clean, quiet, uninterruptible electric power systems for future surface ships such as the SC–21 and CVX. The scope of this effort encompasses advanced power generation and distribution systems incorporating high-power, programmable, solid-state components. By FY00 the program will (1) demonstrate a zero emission, diesel-fed fuel cell module having 300% increase in power density and 30% increase in efficiency for ship service power generation; (2) demonstrate multifunctional power electronic building block (PEBB)-based shipboard electrical power conversion and auxiliary control equipment with networked intelligence and high bandwidth through switching speeds above 70 kHz, cost (also size and weight) reduced by a factor of 10, and a tenfold increase in reliability and current density; (3) develop a common family of intelligent, programmable PEBB-based circuit protection and power switching modules having fault detection and classification in 10–100 microseconds, and distributed intelligent switching capability; and (4) develop networked power system noncontrol methodology that has the ability to automatically reconfigure system topology while maintaining local and global stability. By FY05, the program will demonstrate an advanced, intelligent, reconfigurable, solid-state-based zonal electric power system architecture that has the capability to reconfigure in less than 10 milliseconds.

Payoffs are 100% uninterruptible ship power with a 40% reduction in weight, a 50% reduction in manning, and a 50% reduction in cost while supporting future ship signature and environmental requirements.

Power generation efficiency requires breaking the thermal cycle efficiency barrier with fuel cells that can operate on widely available fuels in sufficient power densities for shipboard use. High-power-density PEBB-based conversion equipment requires packaging that simultaneously delivers electromagnetic compatibility, thermal material matching, and control circuits that can support high switching speeds with low total harmonic distortion. Fault detection and classification algorithms that consistently identify electrical faults in the microsecond time frame are needed. Nonlinear control algorithms that can predict local and global system stability with incomplete overall system status knowledge must be developed. Networked communication with the bandwidth and reliability to implement intelligent control schemes must be designed to realize overall system implementation.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602121N		11.4	3.0	3.0	2.3	2.3	2.2	2.4
0603508N	R2224	3.8	13.0	15.0	15.0	4.0	3.0	0
	Total	15.2	16.0	18.0	17.3	6.3	5.2	2.4

GV.08.01 ***Surface Ship Automation.*** The objective is to develop the technical basis for affordable automation options comprising the following key components: hardened, intelligent sensors; robust control and actuation algorithms; multifunctional, survivable data/control networks; and an intelligent machinery monitoring and control system. The near-term focus is damage control. Automated systems will provide real-time situational awareness and casualty response effecting a 92% reduction in damage control manning by FY00. Technical base efforts in the areas of fiber optic and MEMS-based sensors (i.e., fire and smoke spread, hull integrity, hatch and door closure state, fire main, and ventilation systems status), robust architecture and control concepts, fixed fire suppression systems, and predictive fire and smoke models are providing the foundation for a fully automated damage control system. The Damage Control-Automation to Reduce Manning (DC-ARM) subproject will provide a series of risk-mitigating demonstrations in order to allow for the transition of these technologies into ship acquisition programs. In FY98, DC-ARM will demonstrate a fully automated sensing capability with high reliability in sensor data. In FY99, real-time situational awareness including predictive modeling and decision making will be demonstrated and, by FY00, automated response actions also will be included in the DC-ARM system and demonstrated.

Payoffs will be in the areas of affordability, through reduced manning, and improved fight-through capability, by decreasing the amount of time needed to correct the casualty. In FY98, a 20% decrease in damage control manning will be demonstrated, and the ability to characterize the casualty will go from hours to minutes. In FY99, a 30% reduction in damage control manning will be demonstrated with the ability to characterize the casualty and assess the situation in less than an hour. In FY00, a 92% decrease in damage control manning will be demonstrated, exhibiting the ability to go from characterization of the casualty to corrective response in minutes.

The major technical barriers to achieving the objective are affordable sensors that are survivable, reliable, and intelligent; fault-tolerant, multifunctional networks; component-level architecture with the ability to recover from network fragmentation; affordable component-level control nodes; data reduction, transfer, and storage methods that will enable rapid transfer of information throughout the ship; validated predictive models of casualty situations; and robust control and actuation algorithms that provide rapid and reliable response.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602121N		1.0	1.1	1.3	1.0	1.0	1.0	1.0
0603508N	R2224	0.8	5.0	7.0	7.0	7.0	7.0	7.0
0602707N		10.7	0	0	0	0	0	0
	Total	12.5	6.1	8.3	8.0	8.0	8.0	8.0

GV.09.02 ***Submarine Advanced Machinery Truss Support System.*** The successful completion of efforts in this DTO will enable the development and demonstration of an equipment and machinery support system that provides integrated acoustic quieting and shock isolation performance to support modular construction, use of COTS equipment, and signature reduction. By FY98, a semiactive shock mount will be developed, and a process will be established for evaluating the performance of integrated shock and acoustic mounts; a quarter-scale shock evaluation capability will also be developed and demonstrated. By FY99, final testing of the semiactive shock mount will be completed, and DARPA Project M technology will be transitioned and demonstrated at ISMS. By FY01, a quarter-scale demonstration of a heavy weight truss concept for target strength and radiated noise reduction will be conducted. By FY03, a quarter-scale demonstration of integrated active and passive mount/structural concepts to attenuate shock loads and acoustic signatures will be conducted.

Specific benefits include reduced equipment cost (by at least 40%) through use of COTS equipment, reduced construction costs through modular design and fabrication, increased shock survivability by using semiactive mounts that reduce equipment accelerations by 70%, improved acoustic signature characteristics through application of Project M technology, and design of attenuation into support structure (10–20-dB reduction in low-frequency modes).

Technology barriers include integration of shock and acoustic requirements into large machinery support structures, extension of Project M technology to modular deck structures, and developing and validating scale-model demonstration systems to evaluate both shock and acoustic performance of machinery support structures.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602121N		1.9	2.2	2.6	2.7	2.7	2.8	2.9
0603508N	R2224	5.0	3.7	5.0	5.0	5.1	5.1	5.1
	Total	6.9	5.9	7.6	7.7	7.8	7.9	8.0

GV.10.01 ***Submarine Signature Control.*** The successful completion of efforts in this DTO will enable the development of concepts to control acoustic and nonacoustic signatures that assure a stealth advantage for U.S. submarine forces. By FY97, the program will fabricate and test a prototype active transmission vibration isolation mount. By FY98, the Advanced Vibration Reducer concept will be demonstrated at sea. By FY00, active and passive acoustic signature control concepts will be demonstrated that have reduced weight, volume, and cost impact compared to current acoustic silencing technology and are compatible with shock reduction technology; and concepts will be demonstrated that control electromagnetic signatures to reduce detection and mine vulnerability. By FY01, pressure hull and nonpressure hull design concepts will be developed that provide inherent radiated noise and target strength reduction over conventional design. By FY02, a hydroacoustic simulation capability will be developed to enable reductions in hull flow and propulsor noise and to support reduced design cycle time and testing; and a quiet reduced complexity propulsor (NSSN noise goals) will be demonstrated at large scale. By FY03, coating technology will be developed to enable design of structural concepts for reduced radiated noise and target strength signatures. By FY05, multispectral materials for nonacoustic signature reduction will be demonstrated; and a quarter-scale capability will be developed and demonstrated to design pressure hull and non-pressure hull structures for balanced static and shock strength which can provide at least a 5-dB reduction in acoustic signatures over current hull technology.

Specific benefits include reduced weight, volume, and cost; 10% reduction of signature control costs; 5-dB reduction in radiated noise through application of advanced pressure hull concepts; 3–10-dB reduction in hull flow and propulsor noise; reduction of design, acquisition, and maintenance cost of propulsor through simplified design; and reduction of nonacoustic signatures important in littoral warfare.

Technology barriers are related to the assessment of critical signature sources. As advancements are made in controlling specific noise sources to reduce the overall signature of submarines, previously unimportant noise sources become critical. An integrated approach must be taken to effectively control submarine acoustic and nonacoustic signatures.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602121N		1.6	1.9	2.3	2.3	2.4	2.5	2.5
0603508N	R2224	16.3	2.5	0	0	0	0	0
0603226E	EE-36	5.1	3.6	0	0	0	0	0
	Total	23.0	8.0	2.3	2.3	2.4	2.5	2.5

GV.11.02 ***Submarine Electric Drive System.*** The successful completion of efforts in this DTO will enable the development and demonstration of quieting technology for a main propulsion electric drive system that will provide reduced radiated noise compared to current mechanical drive systems. Enabling technologies that support electric drive, such as power electronic building blocks and solid-state electrical distribution, will also be developed for submarine systems. By FY99, design concepts and analysis tools to evaluate performance of different quiet electric motor concepts will be developed. By FY00, design and analysis tools will be validated through small-scale motor experiments; and design concepts will be demonstrated by building small-scale prototype motors incorporating quieting technology. By FY01, enhanced acoustic performance will be demonstrated through intermediate scale (200–500 hp) permanent magnet (PM) motor experiments. By FY02, quiet electric drive motor/thruster concepts for secondary propulsion systems and electric drive main propulsion units will be demonstrated. By FY05, a quarter-scale demonstration will be conducted on the LSV for acoustic performance.

Specific benefits of electric drive include a 50% reduction in propulsor and main propulsion plant signatures; increased flexibility in machinery space arrangements; reduced submarine volume and cost; and expanded design space for advanced propulsion and maneuvering concepts.

Technology barriers to developing an electric drive system include developing validated electroacoustic design tools, developing PM materials with acceptable material properties, and developing motor controllers and bearings that meet acoustic requirements.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602121N		4.7	3.8	3.9	3.9	1.7	1.7	1.7
0603508N	R2224	1.3	4.2	5.3	4.8	3.3	3.2	3.2
Total		6.0	8.0	9.2	8.7	5.0	4.9	4.9

GV.12.01 ***Mission-Reconfigurable Unmanned Undersea Vehicle.*** Technology demonstrations for the Mission Reconfigurable UUV Technology Program are divided into five fundamental technologies: energy/propulsion, guidance and control, communications, navigation, and signature reduction. For energy/propulsion technologies, the goals are to demonstrate in FY02 a fourfold increase in energy density with a low-life-cycle-cost, rechargeable electric battery energy/propulsion subsystem; and in FY03, an eightfold increase in energy density with a thermal energy/propulsion system, and a 50% reduction in propulsion subsystem volume (3 ft) and weight with an integrated motor/propulsor for additional payload. For guidance and control technologies, the goals are to demonstrate a tenfold improvement in stability and maneuvering, with an adaptive nonlinear "sliding mode" autopilot controller, in FY01; and a tenfold improvement in mission robustness with a fault-tolerant (fault detection and compensation) mission controller, in FY03. For undersea acoustic communications technology, the goal is to demonstrate a twentyfold increase in communications rate and distance, in FY02, for real-time command, control, and tactical data/information transfer. For undersea navigation technology, the goal is to demonstrate a tenfold improvement in navigational accuracy with a low-cost and covert nontraditional geophysical navigation subsystem, in FY01. For signature reduction technology, the goal is to demonstrate a tenfold reduction in EM signature using passive and active methods, in FY03.

Payoffs for achieving these capabilities include an eightfold increase in UUV range/endurance with the thermal propulsion subsystem and a 75% reduction in development and training life-cycle costs with the rechargeable electric battery propulsion subsystem; 3 additional feet of payload area with the integrated motor/propulsor; a tenfold improvement in low-speed maneuvering and stability in energetic environments and a 75% reduction in autopilot controller life-cycle costs; a tenfold improvement in mission robustness; a twentyfold increase in undersea communications data rate and distance, for tactical data transfer; a tenfold increase in covert navigational accuracy; and a tenfold reduction in EM signature for increased stealth, reduced target vulnerability and improved sensor performance. All of these payoffs lead to a common, improved, affordable, and cost-effective Mission Reconfigurable UUV.

The major technology challenges/barriers for developing a Mission Reconfigurable UUV are electrode and cell separator materials for the high-energy density and long life-cycle electric rechargeable battery; steady flow, porous metal combustors with integral heat exchangers for thermal propulsion subsystem reliability; integrated rotor and blade/control surface for motor/propulsor efficiency and noise reduction; adaptation of nonlinear autopilot controller for energetic changing environments; real-time, computationally light algorithms/signal processing for fault tolerance, nontraditional geophysical navigation and undersea communications; high data rate and long-range undersea acoustic communications in a multipath environment; and passive and active signature reduction methodologies.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602633N		8.4	9.7	9.9	10.5	10.3	8.3	7.1
Total		8.4	9.7	9.9	10.5	10.3	8.3	7.1

MATERIALS/PROCESSES

MATERIALS/PROCESSES

MP.01.01 ***Laser Eye Protection.*** Lasers exist on the modern battlefield in a variety of wavelengths and power levels. U.S. forces currently have no protection against high-probability laser (visible spectrum) threats during night operations. Even for daytime missions, the use of protective eyewear creates display and instrument compatibility problems. Although single wavelength solutions exist, more effective multiple wavelength and wavelength-diverse day/night usable protection requires more advanced solutions/materials. The objective is to develop advanced materials (e.g., interference filters, holograms, dielectric stacks, rugates) which provide protection against low-energy-visible and near-infrared devices such as rangefinders, illuminators, designators; as well as protection from higher energy dedicated antipersonnel laser weapons. The need to provide laser threat protection has been documented in the USAF Operational Requirements Document (CAF(TAF 508-87)-I-A) Aircrew Laser Eye Protection, the draft Joint Service Operational Requirements Document for Aircrew Laser Eye Protection currently being staffed for initial review, and in a draft Mission Needs Statement "Laser Eye Protection for Special Operations Personnel" prepared by the 720th Special Tactics Group for HQ AFSOC and USSOCOM. Within the Air Force, two major commands have ranked multiple wavelength Laser Eye Protection in the top 10% of all laboratory efforts in addition to user commands within the Army, Navy, and Marine Corps that have endorsed development and demonstration as high-priority efforts.

Starting in 1998, night-compatible visible wavelength materials/technologies will be demonstrated for air, sea, and land forces. Specific eye protection prototypes will be available by FY99. Hybrid filter technologies to provide enhanced protection against emerging threats for specific missions will be available by FY02.

Technical barriers include optimized transmittance for visual clarity, operation in haze, environmental durability, ballistic protection, manufacturability, and optical signature reduction.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		0.4	0.4	0.4	0.4	0.4	0.4	0
0603112F	2100	2.0	2.3	3.5	4.0	2.4	1.4	0
0603640M	C2223	0.3	0.3	0.3	0	0	0	0
0602712E	MPT-01	0.9	3.8	5.0	5.0	5.0	5.0	0
	Total	3.6	6.8	9.2	9.4	7.8	6.8	0

MP.01.06 ***Plasma Arc Shipboard Waste Destruction System ATD.*** The objective of this program is to develop an effective method of thermal destruction to greatly reduce the volume of shipboard solid waste. Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) prohibits the discharge of nonfood solid wastes from surface ships in designated special areas. While MARPOL explicitly excludes warships, Congress has mandated that U.S. Navy surface ships comply with Annex V by the year 2000. The U.S. submarine fleet has until the year 2008 to meet the discharge requirement. The discharge prohibition requires that the nonfood and nonplastic solid wastes must be either stored or processed at sea and returned to shore for disposal. The daily production of solid waste is voluminous, about 2,200 ft^3/day for a typical aircraft carrier battlegroup.

The program will demonstrate that plasma arc technology can, while operating in a shipboard environment under space and weight constraints, convert shipboard solid waste into an easily storable, benign, nonleachable, solid product which reduces waste volume by a factor of 75 and which meets the Toxicity Characteristic Leaching Procedure (TCLP) requirements. Specific technical milestones are: by FY97, design, build, and test a prototype plasma eductor feed system to reduce the size of the primary reaction chamber; measure the characteristics of the slag formed from Navy solid waste; develop ceramic/cement electrodes to extend plasma torch operating lifetimes to several hundred hours; and measure the erosion characteristics of high-temperature thermal coatings in a plasma environment. FY98 goals are to design and build a lightweight water-cooled reactor chamber that is insensitive to thermal cycling; design and build a safe and reliable molten slag handling system that is compatible with large pitch-and-roll ship motion; and design, build, and test a safe and reliable system to feed waste into the high-temperature reactor chamber. FY99 goals include conducting full-scale thermal destruction demonstration tests at a solid waste process rate of 425 lb/hr, an average operating cycle of 18 hours per day, and a 50% size and weight reduction compared with commercially available units; demonstrating reduced manning operation and training requirements; determining the effects of the waste stream variability on off-gas pollutants, particulates and trace heavy metals; and demonstrating the thermal destruction of concentrated liquid wastes.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	3.0	6.0	5.0	0	0	0	0
	Total	3.0	6.0	5.0	0	0	0	0

MP.02.01 ***Materials and Processes for Integrated High-Performance Turbine Engine Technology.*** The challenge is to double the thrust-to-weight performance of future U.S. turbine engines. The following capabilities will be achieved: a 100% increase in range with a 50% decrease in fuel consumption for advanced fighters, a doubling of aircraft thrust-to-weight ratio for increased fighter maneuverability and payload capacity, and 30% more fuel efficiency in transport aircraft and cruise missiles. This program also benefits the technology base for the development of uninhabited combat air vehicles.

By the end of FY97, materials and processes (M&P) will be developed to enable the demonstration of a 60% increase in thrust-to-weight ratio engine performance. Specific technologies to be demonstrated include ceramic bearings for 1,000°F applications; ceramic matrix composites for 2,500°F non-low-observable nozzles and combustors/augmentors; titanium-based monolithic and metal matrix composite M&P for 1,400°F compressors; and 1,450°F superalloy disks, and 2,200°F advanced intermetallic liners for turbines; and 625°F liquid lubricants.

By FY03, M&P developments will enable a 100% increase in thrust-to-weight ratio engine. Specific technologies to be developed and demonstrated include 3,200°F ceramic matrix composites for non-low observable nozzles and combustors/augmentors; 1,500°F superalloy disks; 1,600°F titanium-based monolithic and metal matrix composite M&P for fans/compressors; 2,500°F advanced intermetallics and 2,800°F ceramic matrix composites for turbines; 700+°F organic matrix composites for fan and ducting applications; and solid lubricant M&P for 700+°F magnetic bearings.

Technical barriers include long-life environmental durability at very high temperatures, high-temperature capability with low-density and balanced engineering properties, oxidation resistance at very high temperatures, affordable processing techniques, improved life prediction methodology, and testing capability.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602102F	2420	9.6	9.6	8.8	7.1	8.2	9.2	0
0602234N		3.4	3.5	3.7	3.8	4.0	4.1	0
0602712E	MPT-01	3.4	0.5	0	0	0	0	0
0603112F	3946	0.1	0.1	0	0	0	0	0
	Total	16.5	13.7	12.5	10.9	12.2	13.3	0

MP.03.01 ***Nondestructive Evaluation for System Life.*** Development and enhancement of crack and corrosion detection methods have allowed systems such as the KC–135, C–141, P3C, and F–16 to operate safely up to and beyond their original design lifetimes. Remotely queried inspection methods are being developed for enhanced flaw detection. Costs are associated with hidden corrosion detection, bondline inspection, delamination, and impact techniques. Specifically, the inspection time required for the F/A–18E/F horizontal stabilator will be reduced by the development of a thermographic inspection technique. The composite ship mast inspection program will be significantly improved by reducing the inspection time and improving detection reliability by using noncontact, wide-area microwave methods. Automated inspection is critical to meeting requirements for engine structural integrity and retirement-for-cause programs. Critical rotating components for variants of both F100 and F110 engines being used in the F–5, F–16, and B–1B aircraft are being inspected at eddy current workstations. The results will be a $40,000 reduction in each of the many crack artifact standards procured for the inspection systems, and a 25% reduction in overall maintenance cost for the inspections systems.

By FY98, the program will demonstrate enhanced turbine engine disc inspection hardware and software; and an in-flight acoustic emission monitoring system for crack detection and localization. By FY00, the goal is to demonstrate enhanced methods for structural crack and corrosion detection. The FY02 goal is to demonstrate and transition to Navy and Air Force depots wide-area inspection techniques for bondlines, corrosion, delamination, and impact damage. By FY03, the program will transition new structural cracking corrosion detection to Air Force and Navy rework facilities.

Technical barriers include the complexity of upgrading older inspection systems and developing more automated NDE methods to reduce maintenance costs and to increase the probability of defect detection in critical rotating machinery; and developing more portable and flexible thermal excitation subsystems and related hardware and software for data acquisition and manipulation.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		4.5	4.0	1.1	1.1	1.2	1.3	0
0602102F	4349	1.9	1.3	1.5	1.9	2.9	3.6	0
0603112F	3153	3.4	5.1	4.8	6.0	5.4	6.7	0
	Total	9.8	10.4	7.4	9.0	9.5	11.6	0

MP.04.01 ***Materials and Processes for Reentry Vehicle Technology.*** The objective is to develop advanced nosetip, heatshield, and antenna window materials and processes to maintain the current intercontinental ballistic missile (ICBM) and submarine-launched ballistic missile (SLBM) reentry vehicle systems at least until the year 2020. The program will address two issues: performance degradation due to aging materials, and inability to replace damaged hardware due to unavailability of precursor products. New precursor materials and processes will be developed to minimize the effects of aging. The minimum requirement from the ICBM System Program Office (SPO) or the Navy Strategic Systems Program office is to maintain current system performance of the Minuteman III and Trident II systems using replacement form, fit, and function materials. System-level impacts would be determined by the ICBM SPO.

By FY98, replacement materials and processes for antenna windows will be available that are moisture resistant and available for flight test by the Air Force SPO. The AF SPO also will integrate both the fuse and the GPS antenna. By FY00, replacement heatshield materials and processes will be available for flight test. (Both of these are form, fit, and function replacements.) Definition of materials aging effects should be available by FY02. This will include an understanding of aging issues and preliminary predictive capability. Replacement materials whose aging phenomenology is well understood and characterized will be available by FY06.

Current ICBM and SLBM reentry vehicle heatshields cannot be fabricated because the rayon fiber precursor is no longer in production. Alternative fibers have different ablation characteristics and thermal/mechanical properties that must be investigated in order to properly design the replacement heatshield. The aging mechanism of current materials is not well understood and needs investigation to ascertain system-level degradation impacts.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602102F	2417	5.9	3.7	4.1	3.9	4.1	4.3	0
0602234N		0.9	1.0	1.0	1.0	1.0	1.0	0
	Total	6.8	4.7	5.1	4.9	5.1	5.3	0

MP.05.01 ***Protective Materials for Combatant and Combat Systems Against Conventional Weapons.*** The objective is to develop and demonstrate ultra light materials and new armor principles to be incorporated into individual soldier protective gear (resulting in a 40% weight reduction); face shields and windows (resulting in a 30% weight reduction); and primary armor for combat systems (resulting in a 30% weight reduction).

By FY99, materials or material systems will be developed for individual combatant protection from small arms threat which will be 40% lighter than current systems; and a 30% weight reduction will be demonstrated in transparent armor materials for face shields and windows with the same protection capability as current systems. By FY04, a 30% weight reduction will be achieved in advanced materials and material systems for armor materials in combat systems.

Technical barriers include the fundamental understanding of monolithic material behavior under extremely hostile environments; the design and synergistic effects of various material systems; interface and interphase effects; manufacturing and fabrication effects on material behavior; and development of material models for simulation.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602105A	H-84	1.4	1.3	1.3	4.0	4.0	4.0	0
0602712E	MPT-01	0.7	3.8	5.0	5.0	5.0	5.0	5.0
	Total	2.1	5.1	6.3	9.0	9.0	9.0	5.0

MP.06.01 ***Computing and Signal Processing Materials for Use in High-Temperature Shock and Radiation Environments.*** Three materials technologies offer the near-term promise of surviving harsh environments with no loss of performance: wide bandgap semiconductors (primarily silicon carbide); magnetic film memory; and thermoelectric thermal management materials. SiC is projected to deliver the performance of silicon at 200°C while operating at temperatures up to 500°C. Magnetic film memories offer radiation-hard permanent information storage with no power consumption, and state-of-the art speed and data density, eliminating mechanical disks or tapes. Thermoelectric materials can provide more than 100°C of active cooling to electronic systems. Critical applications include jet engine control systems, missile and torpedo guidance and control, unmanned vehicles, and satellites. This technology will impact the warfighting areas of Information Superiority (surveillance, data analysis), Precision Force (guided munitions, surveillance), and Military Operations in Urban Terrain (surveillance, navigation) by providing increased time on station and survivability.

By FY00, SiC substrates with low defect densities and large defect-free areas will be available. Manufacture of highly uniform SiC layers will be achieved by process control and optimization. Thermally stable SiC electronics will enable on-engine controls critical to the performance of IHPTET Phase III and all future high-performance turbine engines. Magnetic film structures with relative resistance changes of greater than 10% will be optimized. Thermoelectric figures of merit will be improved by a factor of 3, allowing greater than 100°C cooling in three stages or less.

By FY02, processing techniques required to fabricate devices (lithography, etching, etc.) with targeted memory density improvement by a factor of 10 to 100 will be developed.

Stable materials interfaces at elevated temperatures or in the presence of ionizing radiation must be achieved.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602102F	4348	1.0	1.0	1.0	0.8	0	0	0
0602712E	MPT-01	5.9	10.5	9.1	15.6	9.0	4.0	4.0
	Total	6.9	11.5	10.1	16.4	9.0	4.0	4.0

MP.07.01 ***Materials and Processes for Metal Cleaning, Corrosion Control and Coatings.*** The overall objective is to reduce the $5.5+ billion per year cost to the Navy, Army, and Air Force associated with corrosion control. Specific objectives include developing (1) new and environmentally acceptable cleaning processes and coatings that do not rely on hazardous materials to prevent corrosion and fouling of ship and submarine hulls or to prevent corrosion of aircraft, ground vehicles, and weapon systems; (2) environmentally acceptable means to detect, describe, predict, and prevent the many forms of corrosion which degrade materials used on DoD platforms and systems; (3) advanced aircraft extended-life coating capability with a 30–40-year foundation layer and an 8-year topcoat; and (4) extended durability coatings lasting 5–7 years with only routine cleaning and touchup.

In FY97, the program will develop surface cleaning processes for aircraft painting and plating using solid particulate materials, ultraviolet light and activated oxygen, and biodegradable solid media blasting for aluminum surfaces. By FY98, qualify commercial-off-the-shelf low-VOC (volatile organic compound) paints for use on aircraft and missiles. These COTS paints will satisfy the new (1998) environmental requirements for VOC emissions with demonstrated improved performance over current systems. Also by FY98, the program will develop oxygen plasma cleaning processes for oxygen tubing, low-VOC ship paints, chemical agent resistant coatings, and aircraft painting using supercritical CO2 to replace VOCs. The FY99 goal is to field extended durability (5–7 years) aircraft coating systems that meet increasing environmental and safety requirements and do not require repainting between depot maintenance intervals, as well as a fast-drying coating system for ammunition. By FY03, the program will demonstrate a long-life (10-year) ship antifouling coating for reduced drag and 35% maintenance cost savings, and develop a complete coating system for conventional non-low-observable aircraft as an extended life system (30–40-year foundation layer and 8-year topcoat).

Technical barriers include (1) lack of characterization and demonstration of the suitability of current low-VOC paints to meet current military performance criteria; (2) lack of a strong science base describing the interaction of cleaning agents and coatings with new alloys; (3) lack of environmental durability, stain resistance, cleanability, and ultraviolet resistance in gloss/matte coatings with very low organic solvent content; and (4) a lack of understanding of the mechanisms for corrosion of aluminum alloys and for degradation of long-life coatings.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		2.0	2.0	2.1	2.1	2.2	2.2	0
0602102F	2422	6.1	8.4	7.0	6.2	4.5	3.8	0
0602712E	MPT-01	3.3	3.8	2.2	0	0	0	0
0603112F	3153	0.7	1.1	1.5	1.3	2.6	3.9	0
0603712N	R2206	1.8	1.6	1.5	1.0	0.8	0	0
0603716D	P-470	2.3	0.3	0	0	0	0	0
	Total	16.2	17.2	14.3	10.6	10.1	9.9	0

MP.07.06 ***Affordable Sustainment of Aging Aircraft Systems.*** The objective is to develop and demonstrate affordable repair and remanufacturing technologies and practices to deal with the extraordinary demands imposed by using current weapon systems far beyond their intended design life. It addresses the near-term, system-driven needs of depots, and private-sector activities providing this capability. During the next 5 years, the focus is on three key ownership cost issues: inspection and repair of aircraft structures for hidden corrosion and fatigue damage; avionics parts obsolescence; and repair of aging propulsion systems for aircraft. Repair cycle time will also be attacked in parallel with cost to improve readiness by returning warfighting assets to service more quickly to offset the negative readiness impact of more frequent repair required for aging systems. This DTO will establish industrial base and organic capabilities to support life extension of aging aircraft systems, reduce life-cycle costs, enhance operational readiness, and advance lean concept deployment in repair.

The FY97 milestone is transition of an automated high-pressure waterjet paint stripping capability to OC-ALC reducing hazardous waste by 94% and depaint hours and flow time by 50% for aircraft structures. By FY98, current capability to reverse engineer and produce obsolete avionics microcircuits will be expanded by 85%. By FY99, the reverse-engineering capability will be expanded to include form-fit-function emulations for medium- and large-scale integrated circuits. By FY00, turbine engine blade overhaul costs reductions of $11 million/yr will be demonstrated and the capability to repair thin-walled blades will be established. By FY00, the feasibility of reducing overall depot maintenance cycle time 50% through leveraging the best commercial technologies and practices will be demonstrated. By FY01, sharply enhanced nondestructive inspection (NDI) techniques will be demonstrated for detecting hidden structural corrosion and fatigue damage without aircraft disassembly.

Technical barriers include lack of quantitative NDI techniques for detection and evaluation of hidden corrosion and cracks; lack of tools to reverse engineer obsolete microcircuits to support the design of replacement parts which preserve original design intent; lack of tools to predict the failure of obsolete parts; lack of effective techniques for turbine blade high-cycle fatigue resistance enhancement; lack of effective techniques for thin-walled blade repair to support propulsion overhaul; and lack of existing repair tooling and workload planning geared to batch processing of assets

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0708011N*		1.0	0.8	0.7	0.7	0	0	0
0708011F*		4.6	8.0	10.0	12.0	4.0	0	0
0708011S*		2.0	2.0	2.0	2.0	0	0	0
	Total	7.6	10.8	12.7	14.7	4.0	0	0

*Non-S&T funds.

MP.08.06 ***Affordable Multimissile Manufacturing ATD.*** This ATD will demonstrate advanced missile design and manufacturing enterprise concepts and systems that can reduce the cost of tactical missiles by 25–50%. A key concept is the use of flexible multiproduct manufacturing as opposed to dedicated production lines for each missile. Benefits for the missile acquisition community include the ability to afford up to twice as many missiles within a fixed budget, faster development cycles to keep up-to-date technology in the field, and a residual base of new competitive capabilities that can respond rapidly to warfighter needs.

Milestones include, by FY97, completing concept definition and validating savings across the entire DoD tactical missile portfolio through cost modeling and simulation; and initiating a series of component- and system-level demonstrations to resolve risks in flexible multiproduct manufacturing. By FY98, the program will demonstrate multimissile component designs, integrated information systems for missile enterprises (including supply chains), and manufacturing facilities that can meet tri-service needs with a single set of technical and business processes. The FY00 goals are to implement at least two cost-shared pilot multimissile enterprises; demonstrate new production methods and flight qualify new hardware for at least two missile systems; demonstrate, at the missile level, the feasibility of reducing the unit cost of ongoing missile production programs by 25%; reduce development and production cost for new missile and major upgrades by 50%; reduce the dependence of unit cost on lot size; and reduce development cycle times by 50%. The FY01 goal is to transition for implementation across the entire missile portfolio.

A key technical barrier is the development of product-line architectures to increase design reuse and parts commonality. Additional challenges are the integration of heterogeneous information systems and processes across missile supply chains; and the development and integration of flexible assembly/test systems for multiproduct production.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603739E	MT-08	11.7	25.0	25.0	22.0	0	0	0
	Total	11.7	25.0	25.0	22.0	0	0	0

MP.09.06 ***Producible Designs for Affordable Force Modernization.*** The objective is to develop and demonstrate the advanced information technologies needed for much shorter, lower cost development and production cycles for complex electro-mechanical systems. Tools and integration capabilities will be developed for creating more producible designs and efficiently exploring many more design alternatives prior to design release. Emphasis will be placed on integrating geographically distributed IPPD teams, including suppliers. Tools will be provided for selection of lowest cost, lowest variability processes, for accurate cost and producibility assessment at all design stages, and for rapid access to manufacturing information wherever it resides. This DTO will meet acquisition community needs for tools addressing cost as an independent variable (CAIV).

The FY97 milestone is to integrate detailed parametric cost models, producibility analyses, and assembly simulations to address cost as an independent variable for missile seekers and other complex assemblies. By FY98, the program will demonstrate a 75% reduction in design and test time for electro-mechanical subsystems through design re-use, supported by the ability to automatically share design rationale in addition to design features. The FY99 goal is to transition a distributed design environment for IPPD in missiles and similarly complex electro-mechanical systems, with the ability to address cost as an independent variable early in conceptual design and achieve highly producible designs in less time. By FY00, demonstrate the ability to explore ten times more alternatives in conceptual design in one-half the time, achieve a 30% reduction in design-to-production transition time for electro-mechanical assemblies, and demonstrate accurate cost estimating tools for conceptual design. By FY01, the goal is to demonstrate a 30% reduction in time and cost to integrate mechanical and electrical designs.

Technology barriers being attacked include the lack of methods and standards to integrate design and analysis tools and to capture and communicate design intent; methods and tools for accurate cost and producibility analyses at all design stages; the ability to simulate the downstream effects of design decisions early in the concept phase; and methods and tools to integrate process capability and factory capacity data into the design process.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602702E	TT-03	14.1	0	0	0	0	0	0
	Total	14.1	0	0	0	0	0	0

MP.10.06 ***Interferometric Fiber Optic Gyro Flexible Manufacturing ATD.*** The objective is to reduce the cost of Interferometric Fiber Optic Gyroscopes (IFOGs) by improving production processes and the design of IFOG and its components. The emphasis is on design and manufacturing flexibility to make low-volume defense components comparable in cost to high-volume commercial production, with cost goals a factor of ten lower than current military IFOGs. Tactical grade IFOGs will be inserted in missiles such as AMRAAM Lots 8 and 9 for cost and performance improvement. Navigation-grade IFOGs will be inserted in next-generation, low-cost precision navigation programs, such as the Global Positioning System Guidance Package Program, to meet warfighter needs for affordable smart weapons that can maintain precision navigation during GPS blackouts.

In FY97, the program will demonstrate a tenfold improvement in cost per axis (goal: $500/axis) for tactical grade IFOGs while maintaining system performance requirements in completed gyros; and develop large-throughput robotic assembly packaging and testing technologies necessary to fabricate navigation grade (0.01 deg/hr) IFOGs at less than $1,500/axis, for accurate (1 nmi/hr) inertial navigators. The FY98 goal is to demonstrate from the same production line flexible fabrication of navigation grade, military tactical grade (0.1–1.0 deg/hr) IFOGs and lower performing commercial IFOGs. The program will leave in place a residual base of manufacturing capabilities to meet the production goal of low-cost ($15,000) precision navigation systems.

Technical barriers include labor-intensive manufacturing steps such as fiber-winding, optical interconnections, and testing; providing affordable optical sources; lowering fiber production costs and providing low-cost environmentally robust packaging; and integrating manufacturing systems to provide a flexible multiple-grade integrated process/production line for tactical and navigation grade IFOGs.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603739E	MT-08	20.3	5.1	0	0	0	0	0
	Total S&T	20.3	5.1	0	0	0	0	0
0708011F*		3.3	0	0	0	0	0	0
	Total	23.6	5.1	0	0	0	0	0

*Non-S&T funds.

MP.12.11 ***Higher Sea State Logistics Support for Expeditionary Forces***. This DTO is intended to provide affordable solutions to support combatants and amphibious/sealift ships power projection. The program will establish a critical sealift support link by developing an advanced cargo beaching lighter (ACBL) for ship-to-shore operations in higher sea states and for offloading supplies to the beach or at the elevated causeway (ELCAS) pier. Technical improvements will provide better stability in sea state 3 and greater payload capacity. Modular construction techniques will permit more configuration options than presently exist for Navy lighterage systems. Future logistics improvements will overcome significant operational and safety barriers in reducing the installation time for the ELCAS. The urgency of achieving improved near-term and far-term logistics capability has been repeatedly expressed from direct fleet inputs via Command Technology Initiatives and in the Navy'sS&T Requirements Guidance.

Specific milestones include, in FY99, demonstrated assembly and connection in open seas (at sea state 3—previously limited to SS1+) of ACBL platforms for an advanced modular causeway lighterage, increasing structural efficiency by 300%, and bending moment resistance by 20%. This DTO will also demonstrate the feasibility of increasing operational availability in projected LIC/MIC scenarios in high sea state regions, such as the Far East, from the present 15-day limitation to 25 days, while increasing cargo capacity from one M1A3 Abrams Tank to three. By FY00, the goal is to reduce pile cutting time from 20 minutes to under 5 minutes for ELCAS installations, using 300% less manpower, with a maintainable plasma arc system easily handled without the use of construction cranes. By FY01, the program will demonstrate feasibility of the plasma arc tool to reduce pile splicing times from 60 minutes to under 5 minutes with the same reduced manpower criteria and ease of use and maintainability. By FY01 the goal is to demonstrate the capability to reduce from 1 week to 48-hours on-site ELCAS geotechnical pre-installation surveys by directly correlating acoustic impedance and attenuation patterns to required soil properties.

Specific technical barriers include wave-induced motion simulation of modules floating in proximity, and connection systems with relative motion compensation and large force attenuation; load testing and modeling simulations via virtual prototyping; plasma arc cutting and splicing; mechanical gripping and finite element analysis; acoustic reflections of near-shore sub-bottoms correlated with ground-truth soil classification profiles; and multifrequency acoustic transmissions correlations with soil properties.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602233N		1.2	0	0	0	0	0	0
0602121N		0	1.2	1.0	0.8	0.4	0	0
0603712N	T-1816	1.6	1.5	1.2	1.0	1.0	0	0
	Total	2.8	2.7	2.2	1.8	1.4	0	0

MP.13.11 ***D-Day Fuel Support for Expeditionary Forces.*** The goal is to provide affordable solutions to support combatants and amphibious/sealift ships for power projection. This DTO will establish sealift support link from a seabase through ship-to-shore operations, and provide the capability to efficiently transfer upwards of 100,000 gal/day from ship to shore in assault operations over standoff distances of a minimum base of 25 nmi compatible with amphibious (L-class) shipping and LCAC operations. The urgency of achieving improved near-term and far-term logistics capability has been repeatedly expressed by the Marine Corps and Navy.

In FY99, the program will demonstrate a fivefold cost-effective lightweight, high-strength, collapsible, continuous spiral woven fuel bladder prototype of 500-, 5,000-, and 15,000-gal meeting pressure and load requirements for LCAC delivery from 25 miles offshore within the 30-minute load/offload LCAC cycles. It will establish the feasibility of constructing a 50-in diameter seamless three-dimensional woven sleeve with replaceable liner (100-gal capacity/ft length) with a 60-psi burst strength low-elasticity bladder with a minimal footprint of 7 psi; and demonstrate deployment and ease of operator handling aboard an LCAC of two 5,000-gal systems in an ISO package (dry–8' x 8' x 20'). By FY01, the program will demonstrate 100% improved bulk liquid transfer containerized transfer systems for quick offload to maneuver elements, and establish the feasibility of utilizing 67% lighter weight, improved tear resistant packaging concepts.

Technical barriers include applying combined simultaneous spiral and helical weaving technology to high strength bladders; thin membrane performance modeling; composite structural analysis; materials properties, shelf life and fatigue testing, abrasion-resistant-oriented fibers; and surge suppression and explosion effects modeling.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602131M		1.7	1.1	0.8	0.5	0	0	0
0603640M	C2153	0	0	1.9	1.5	1.5	0	0
0603712N	T1910	0.7	1.2	0.8	0	0	0	0
	Total	2.4	2.3	3.5	2.0	1.5	0	0

MP.14.11 ***Wartime Contingencies and Bare Airbase Operations.*** The airbase is the heart of the airpower weapon system. These technologies support the improvement of that portion of the airpower weapon system. This DTO will demonstrate technologies for wartime contingencies and bare base operations to include airmobile shelters, utility systems, and rapid pavement repair systems reducing airlift, response time, and costs for execution of global reach doctrine. It supports establishment, operation, and recovery of mission-critical functions on mobile airbases that directly support DoD global reach capabilities. The technology impact is a 14% reduction in airlift requirements for an 1,100-man bare base, representing 50:1 return on dollars invested.

Milestones include development of new airmobile shelter systems that reduce weight by 50%, thermal losses by 100%, costs by 20%, and setup time by 50%, and use innovative geometric designs and lightweight high-performance composites. Near-term shelter systems will be demonstrated by FY97, and advanced designs by FY03. The program will develop lightweight generators to exploit advanced permanent magnet disk and rotary-engine technologies, resulting in reduction of weight and volume by 50%; mobile heat pump units based on acoustic cycle technology to reduce weight by 50%, volume by 40%, and increase efficiencies by 30%; and demonstrate the bare base generator by FY97. The FY99 goal is to develop lightweight heat pump increasing efficiencies and further reduce weight and volume. New technologies will advance waste disposal systems by FY01; solid oxide fuel cells and environmentally clean alternate fuel systems by FY02; and large low-signature shelters by FY06. Reduced logistics needs for bare base operations will greatly enhance the mobile warfighting capability and reduce costs for contingency operations.

Technical barriers for shelters include optimization of composite materials for panels and connection systems, inflatable shelter materials, and self-erecting mechanical frame concepts. The major technical barrier for the lightweight generator is developing high-speed, high-voltage switching devices required to generate reliable 4,160-V power. The mobile heat pump's technical barrier is the design of acoustic pulse-tube cycle to best eliminate the need for conventional evaporators and condensers.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602201F	4397	1.1	0.3	0.6	0.9	0.8	0.5	1.3
0603205F	4398	0.9	0.9	1.5	1.6	1.2	1.0	0.4
	Total	2.0	1.2	2.1	2.5	2.0	1.5	1.7

MP.16.06 ***Firefighting Capabilities for the Protection of Weapon Systems.*** This DTO will develop enhanced firefighting agents, crash fire rescue vehicles, fire detection and suppression systems, firefighter protective equipment, and firefighter training systems to increase protection of weapon systems against current and emerging operational and wartime fire threats. Improved capabilities will reduce casualties and fire damage, conserving scarce warfighting resources and contributing to a more rapid return of fighting capability to operational status. Effectiveness of firefighting capabilities is a function of an integrated architecture of multiple technologies (i.e., agents, detection/suppression systems, and firefighter equipment and training).

Firefighting research will develop advanced firefighting agents, equipment, and techniques required by DoD to effectively combat aircraft, shipboard, fixed and mobile weapon systems, facility, munitions plant, and hazardous materials fires. This research includes exploring new capabilities; cryogenic technology for improved firefighter body cooling and breathing air; machine vision and dual-spectrum ultraviolet/infrared for ultra fast and reliable fire detection; exploitation of advanced automation and navigation technologies for crash fire rescue vehicles for effective inclement weather crash rescue response; and virtual reality technology for more effective safe firefighter training systems.

By FY97, the program will demonstrate enhanced large-frame aircraft firefighting capabilities, a fine water mist ship fire suppression system, and an ultra fast water deluge fire suppression system for DoD munitions plants. The FY99 goal is to develop replacements for Halon 1211 and AFFF firefighting agents and a hypergolic fuel vapor detection/fire suppression system for space-lift facilities. By FY02, the program will develop a day-night/all-weather emergency response fire crash rescue capability, a virtual reality firefighter training system, and next-generation aircraft fuel fire suppression agent.

Technical barriers include the synthesis of new, more effective fire suppressant compounds that can more rapidly extinguish new weapon system materials and fuel fires yet be environmentally and toxicologically safe both in the neat form and in combination with combustion products produced during the extinguishing process.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602201F	4397	0.3	0.1	0.7	0.8	0.6	0.5	1.3
0603205F	2978	0.7	0.4	0.3	0.6	0.6	0.6	0.5
0602121N		0.7	1.0	1.3	1.0	1.1	1.3	1.1
0602233N		1.1	0	0	0	0	0	0
0603792N	R1889	0.9	0.1	0	0	0	0	0
	Total	3.7	1.6	2.4	2.4	2.4	2.5	3.0

Note: Totals may not add due to rounding.

MP.17.06 ***Hazardous and Toxic Waste Treatment/Destruction for DoD Operations.*** Technologies in this area provide advanced "end-of-the-pipe" solutions for difficult-to-destroy wastes from DoD operations. Technologies will be developed, demonstrated, and implemented to reduce operational costs while increasing mission effectiveness. Operation and maintenance of weapon systems and installations will continue without threat from stringent environmental laws by advancing the development of technologies that reduce the volume of wastes requiring disposal, or completely destroying pollutants before their emission into the air, water, or soil.

Technical demonstrations and goals include technical feasibility and cost benefit analysis of non-thermal plasma (FY97); regenerative sorbents (FY97) and advanced catalysis (FY99) to reduce NOx emissions by 90% from jet engine test cells, aerospace ground equipment, and jet aircraft; and risk-based atmospheric emission decision tools to improve space launch vehicle availability by 50% (FY00). Together, these air quality technologies achieve $250 million of annual cost avoidance and avoid decreased or interrupted operations tempo. Technical demonstrations for solid and liquid wastes include advanced oxidation (FY97); reductive electrochemical processes and advanced chemical reactors (FY00); and biotechnology for treating wastes from the manufacturing and disposal of propellants, explosives, and pyrotechnics (PEP) and complex industrial hazardous wastes (FY02). These technologies will reduce current annual hazardous waste disposal costs by up to 50% ($75 million in FY95).

Technical barriers to be addressed include the economical and energy-efficient chemical and physical separation of complex of waste streams; process optimization using variable concentration waste streams; nonthermal destruction of recalcitrant wastes; the instability of highly energetic materials; and the destruction or conversion of waste and contaminants without the production of unwanted toxic byproducts.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602720A	D048	0	1.2	1.6	1.6	1.1	0	0
0602202F	1900	3.5	2.3	3.7	2.1	0.1	2.0	0
0603723F	2103	2.6	1.1	0.5	2.3	1.7	2.8	0
0603716D	P-470	1.8	0.9	1.1	0.3	0.3	0	0
	Total S&T	7.9	5.5	6.9	6.3	3.2	4.8	0
0605502F*	3005	0.2	0	0	0	0	0	0
	Total	8.1	5.5	6.9	6.3	3.2	4.8	0

*Non-S&T funds.

MP.17.11 ***Airfields and Pavements To Support Force Projection.*** The objective is to support force strategic deployment from CONUS and operational employment in theater of operation (TO) by providing improved reliable airfields and pavements. The objective will be obtained by developing criteria for design/repair/material systems.

By the end of FY98, the program will provide reliable airfields and pavements to support current generation of military and Civilian Reserve Air Force aircraft and vehicles through the use of local materials, which may be of inferior quality, and pavement binder modifications, resulting in a 10% reduction in construction and maintenance cost. This objective will require new technologies for material characterization, specifically in nonlinear visco-elastic and visco-plastic behavior and how that behavior affects airfield and pavement performance. By the end of FY99, the goal is to provide construction/design/repair systems to decrease construction effort by 10% for expedient surfaces in TO for military aircraft and vehicles. The FY02 goal is to provide reliable airfields and pavements to support multiple passes of proposed future generation aircraft.

Technical barriers include the need for a better understanding of multiple tire interaction, dynamic loading, and linear and nonlinear material response to those loadings. Specific aircraft that can damage airfields include C–141, C–17, and the proposed million-pound aircraft. Vertical/short takeoff and landing aircraft also pose a significant problem. In general, aircraft loads will continue to increase, but the landing gear for proposed cargo aircraft will remain similar to the Boeing 777 configuration. Larger landing gear are not desirable because they consume too much of the cargo space. Therefore, load per tire and tire pressures will continue to increase, resulting in the need for airfields with an increased load carrying capability. The results of the research will increase the functional life of airfields and pavements by 10 years, resulting in a 20% reduction in maintenance costs and a 10% reduction in construction costs.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602784A	T-40	0	1.9	2.0	1.6	1.7	1.7	0
0602201F	4397	0.4	0.1	0.1	0.3	0.2	0.1	0
0603205F	4398	0.2	0.5	0.4	0.6	0.6	0.6	0
	Total	0.6	2.5	2.5	2.5	2.5	2.4	0

MP.18.06 ***Cleanup of Contaminants.*** This program reduces the cost of contaminant cleanup be as much as $10 billion. The objective is to provide cheaper and more effective technologies for the characterization and treatment of explosives/energetics, heavy metals, and dense non-aqueous phase liquids (DNAPL) contaminated soils and groundwater at DoD sites—currently estimated at over 21,000 sites with a total cleanup cost of $30–35 billion. Numerous treatment technologies are required to address the great number of possible contaminant and site combinations, while characterization/assessment technologies provide the means to determine the optimum treatment at a site.

FY98 milestones include advanced sensors and samplers for on-site, real-time detection/monitoring with a 50% cost savings over FY95 monitoring well/analytical laboratory processes; and ex situ bioremediation for explosives/energetics and in situ biological treatment processes concept guidance reducing cost or enhancing cleanup efficacy by 50%. FY99 milestones include an environmental risk assessment framework reducing cleanup design costs by 20%; and rapid detection and in situ treatment of DNAPL reducing costs by 50%. The goal for FY00 is a multisensor/multispectral array for remote detection of surface/subsurface unexploded ordnance with a cost saving of 35%. FY01 goals are fate and transport models/simulations integrating earth media providing rapid contaminant fate predictions, assessing on-site risks, and reducing design costs by at least 30%; and an in situ heavy metals extraction and treatment below existing structures reducing costs for lead removal from $100–300/ton to $50–150/ton. The goals for FY02 include advanced visualization supporting on-site assessment during all cleanup phases reducing data analysis and treatment selection time by 50%; and increased efficacy and flexibility of advanced groundwater remediation for TNT and other energetic materials with an overall cost reduction of $1–5/kgal in FY95 to $0.10–2.00/kgal.

Technical barriers include site heterogeneity (soil, water, and climate); the large number, varying concentrations, state of mixing, and unmapped contaminants encountered at cleanup sites; the inherent complexity of biological, chemical and physical phenomena and technologies; the density and opaqueness of earth media; and differing views of acceptable risk held by local regulators and stakeholders.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602720A	A896	2.3	2.6	3.9	3.1	3.2	4.5	0
0602202F	6302	2.7	2.1	1.0	0.2	0	0	0
0603723F	2103	2.2	1.5	1.4	1.8	0.8	0	0
0603716D	P-470	11.3	11.9	10.2	10.0	10.0	0	0
	Total S&T	18.5	18.1	16.5	15.1	14.0	4.5	0
0605502F*	3005	1.5	1.0	0	0	0	0	0
	Total	20.0	19.1	16.5	15.1	14.0	4.5	0

*Non-S&T funds.

MP.18.11 ***Life-Extension Capabilities for the Navy's Aging Waterfront Infrastructure.*** This DTO will provide affordable solutions to extend the useful life and reduce recurring maintenance costs of waterfront structures required for berthing, resupply, maintenance, and overhauling naval combatants. New upgrade concepts feature the use of composite materials to restore structural strength while minimizing the weight and impact on port operations, and satisfy new mission requirements by increasing deck capacity to perform extensive pier-side overhauls using truck-mounted cranes with concentrated outrigger loads of up to 120 tons on 50-year-old piers. They provide new pier upgrade alternatives costing about $5 million for a typical pier instead of the current practice of demolish-and-replace at an average of $30 million. New repair methodologies will increase pier repair durability from 3 years to 15 years. The urgency of achieving affordable waterfront life-extension capabilities has been expressed in direct fleet inputs via command technology initiatives and in the Navy S&T Requirements Guidance.

By FY98, the program will demonstrate the feasibility of using composite structural upgrades to uniformly increase pier load capacity by 40%; and show capacity increases up to 750 per ft^2, a 300% gain, in supporting 100,000-lb maximum load mobile cranes, at 20% the cost of demolishing and replacing with a new structure. The FY99 goal is to demonstrate a 100% improvement in determining forces for berthing ship-composite fender interactions. By FY00, the program will demonstrate the feasibility of utilizing sacrificial titanium-sprayed corrosion arrestment techniques to extend the service life of reinforced concrete waterfront facilities by 20–30 years.

Technical barriers include pseudo-ductile load response of composite components and concrete hybrid structures; modeling polymer matrix/fiber interface behavior and slip; modeling concrete substrate deterioration from galvanic cells activated by prior repair work; modeling transient viscous flows; nonlinear surface effects; pile-soil interaction from lateral and seismic forces; corrosion stabilization of steel reinforcement using arc-sprayed titanium film applied anodes; and bio-effects data collection for composite structural members.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602233N		0.8	0	0	0	0	0	0
0602121N		0	0.9	0.9	0.2	0	0	0
0602234N		0.8	0.8	0.8	0.8	0.2	0	0
0603712N	T1910	1.5	0.8	0.8	0.8	0	0	0
	Total	3.1	2.5	2.5	1.8	0.2	0	0

MP.22A.06 ***Capable Electronics Manufacturing Processes.*** The objective is to improve first-time manufacturing yield at all levels of electronics integration to achieve 50% cycle time reduction and 30% cost reduction for missile components, radar upgrades, and space power generation. Levels of integration include advanced electronic materials, active components, printed wiring boards, and box-level assemblies. The targeted manufacturing and assembly processes are used in acquisition and support of weapon systems over the full life cycle. Improvements are achieved through product and process design changes; integration of manufacturing, test, and support systems; and use of best commercial processes and facilities. Customers include aircraft, rotorcraft, missiles and munitions, land combat vehicles, soldier systems, and surface and subsurface naval platforms.

Milestones for missile seekers include, by FY97, demonstrating a process capability index (Cpk) of 1.33 for linear cooler manufacturing; developing nondestructive evaluation capability for IR arrays for Javelin; and demonstrating a 20% cost reduction in MM Wave Transceiver manufacturing for Longbow. By FY98, the objective is to demonstrate a repeatable rugate protective coating process for windows and domes with a rapid cycle capability of 21 days from design to first article. For radar components, the goal is to demonstrate a 3:1 cost reduction for Aegis T/R module manufacturing though high-density interconnects by FY01. The FY97 goal for space systems (DSP, SBIR, DSCS) is to demonstrate high-yield manufacturing of multiple band-gap solar cells at Cpk of 1.33 for 2 x 2 cm cells, and 4 x 4 cm cells by FY99, increasing power by 50% at costs comparable to single junction solar cells.

The commercial electronics industry has developed high-volume capability, and the challenge is to adapt it for low-volume, complex parts mix. Specific barriers include high first-time yield for high-performance military environment; high-process capability for low volumes; appropriate statistical process control tools and implementation approaches; and open architectures to support the extended life cycles of weapon systems.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0708045A*		6.7	6.6	6.8	6.8	7.0	7.0	0
0708011N*		6.8	4.9	4.1	4.2	4.4	4.4	0
0708011F*		2.9	7.2	7.3	7.7	12.4	12.4	0
Total		16.4	18.7	18.2	18.7	23.8	23.8	0

*Non-S&T funds.

MP.22B.06 ***Capable Metals Manufacturing Processes.*** This DTO will develop affordable, robust manufacturing processes and capabilities for metals and special materials critical to defense applications over their full life cycle. It will also provide new processing, joining, and inspection methods for current and future aircraft; rotorcraft; land combat vehicles; surface and subsurface naval platforms; space systems; artillery and ammunition; and defense industry manufacturing equipment. It meets customer-driven needs for affordability, cycle-time reduction, insertion of superiority technology, long-term sustainment, and reduction of environmentally degrading pollutants or emissions. Over the next 5 years, the goal is to reduce the cost of welding titanium structures 30–50%; reduce by 50% the tooling and manufacturing man-hours for metal parts for fighter aircraft (e.g., F–22); and reduce casting lead times for metals structures by 50–60%.

Special material milestones include developing an induction heat treating process to fabricate dual hard steel from single plate of steel armor and provide for an 80% reduction in production cost (FY98), and demonstrating a manufacturing process for cast Gamma TiAl engine structures that will allow for up to a 40% weight reduction in major components (FY01). Processing methods milestones include reducing cutting tools spindle chatter by 25%; introducing the use of titanium metal structures at 60% of the weight of steel; and demonstrating ultra machining technologies for larger components/systems that result in reductions in number of components (15%), parts count (40%), cycle time (50%), weight (10%), and cost (15%) (FY00). Joining milestones include developing gas tungsten arc welding fluxes to increase weld penetration by a factor of 2 to 4, reducing weld time, distortion and simplifying joint preparation (FY97); and implementing a programmable automated welding system in Navy shipyards to provide a 30–50% cost reduction (FY98).

No heat treating process exists to fabricate dual hard steel from single plate of steel armor; affordable manufacturing process needs to be developed to realize the benefits for Gamma TiAl engine structures; machine tool spindle vibration limits the capabilities of reduced machining time cycles; there is distortion in welded structures and lack of automation in naval shipyards; and multiaxis vibration testing of fuses requires long test cycles and high test equipment costs.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602712E	MPT-01	11.7	9.9	7.6	3.0	7.0	3.0	0
	Total	11.7	9.9	7.6	3.0	7.0	3.0	0

MP.22C.06 ***Capable Composites Manufacturing Processes.*** The objective is to produce composite structures that can compete with metal structures not only on a structural performance basis, but on a cost basis. This will facilitate increased use of composite structures, in turn increasing weapon system effectiveness. To have a major impact on high cost of material and manufacturing operations, the entire composite structure development process must be considered. This DTO will develop the tools and technologies necessary to enable aircraft designers to confidently design an all-composite airframe utilizing revolutionary design and manufacturing concepts to enable breakthrough reductions in cost and weight. This will be demonstrated in the ability to move from concept to flight readiness in 2 years. The technologies developed under this initiative will be applicable to the entire composites industrial base. Customers include fighter, transport, surveillance, and rotorcraft aircraft, in addition to naval surface and submarine vessels, gas turbine engine structures, and land vehicles.

FY97 milestones include fabricating and testing two multifunctional radome prototypes for the F–22 demonstrating a 50% reduction in span time, a 39% reduction in acquisition cost, and improved quality (reduced variability); and demonstrating a 50% cost reduction in the production of selected aircraft structures for the F/A–18E/F. By FY98, the program will complete fabrication of the second composite armored vehicle ATD hull and begin testing to validate performance, weight, and cost goals. The FY99 goal is to demonstrate revolutionary design and manufacturing technologies on a fighter aircraft demonstrator to quantify cost and performance improvements. By FY00, the program will demonstrate initial tools and methodologies for national industrial base. By FY01, the goal is to characterize and mature resin transfer molding and fiber placement technologies with the goal of achieving Cp of 2 and Cpk of 1.5 to improve cost quality and reliability for systems applications such as F–22, RAH–66, F/A–18F/F, and JSF.

Technical barriers include the lack of effective design cost and manufacturing tools and practices for composites; lack of integrated databases to support design; and a poor understanding of process capability shortfalls and cost drivers.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0708045A*		3.1	2.4	2.3	2.4	2.4	2.4	0
0708011N*		10.1	6.8	5.9	6.1	6.5	6.5	0
0708011F*		2.1	9.8	12.1	11.1	14.1	14.1	0
Total		15.3	19.0	20.3	19.6	23.0	23.0	0

*Non-S&T funds.

MP.23.06 ***Affordable, Short-Lead-Time Parts Production and Repair.*** This DTO will provide the logistics and acquisition communities the information technology for rapid and efficient response to unanticipated changes in production and repair requirements. It will develop and demonstrate the system integration needed to reduce cycle time by 50% for low-volume military system repair and spare parts production. It will also emphasize networked technologies to rapidly access and communicate technical and business information throughout manufacturing facilities; to interoperate manufacturing planning, scheduling, and control systems; and to integrate their critical supply chains (which account for over half the cost of most DoD weapon systems). The program will show how to leverage information technology to reduce inventories by 50% and production and repair lead times by 50%.

FY97 milestones include demonstrating a 70% reduction in order issuance time at Ogden ALC, and validating the potential $2.5 billion life-cycle cost savings on JSF by advanced process planning and machine tool programming technologies. By FY98, the program will demonstrate a 20% reduction in in-process inventories in electronic connectors production, and 40% production cycle time reduction at Rock Island Arsenal by integrating scheduling with shop floor tracking systems and advance scheduling technologies. The FY99 goal is to demonstrate a potential 50% reduction in time to transition new machined parts design to production through new machine tool models and integrating them with programming technologies. By FY01, the program will demonstrate a 50% reduction in supply chain management costs through business systems integration throughout supply chains; and demonstrate a 50% reduction in lead time and inventory for military uniforms by fully integrating digital recruit measurements with automated factory planning and scheduling applicable to custom garment fabrication.

Technology barriers being attacked include the inability to interoperate manufacturing and technical information systems within and among manufacturing and repair facilities, inability to rapidly access weapon system product data essential to technical data packages for repair and reprocurement, and lack of electronic commerce capabilities usable and affordable by the small firms that compose most of the supplier base.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603739E	MT-08	34.3	0	0	0	0	0	0
	Total	34.3	0	0	0	0	0	0

MP.24.06 ***Missile Defense.*** Weight growth of emerging missile interceptor systems erodes interceptor performance and reduces available battlespace. Composite structures and associated fabrication processes are being developed to enable lighter weight, lower cost missile interceptor components and structures.

Test results from the composite divert and attitude control system bulkhead will be ready for evaluation by the Theater High-Altitude Area Air Defense (THAAD) Program Office in FY97. A composite battery box and a bulkhead with integrated sensor pedestal for the PAC–2 interceptor have been fabricated. Weight savings of 40% or more have already been demonstrated for these two components. Evaluation of these PAC–2 components will be completed in FY97. Fabrication of a PAC–3 gimbal post and electronics is being planned for FY97; evaluation will be completed in FY98. An aeroshell for the seeker electronics with integrated electromagnetic shielding will be fabricated for PAC–3 in FY97. Testing of braided carbon-carbon vectorable rocket nozzles with low-cost composite flex seals will continue in FY97–98. Fabrication of a composite aft flare and other components for the THAAD booster are planned for completion in FY97 with evaluation planned for FY98.

Technical barriers include high-strength/high-stiffness carbon fibers that allow fabrication of interceptor structures with natural vibration frequency approaching 600 Hz, important for achieving hit-to-kill accuracy. Cost and weight savings more than 25% over baseline (typically machined aluminum) have already been demonstrated for several composite missile components. The primary technical challenges that remain are to demonstrate and evaluate fabrication and performance of interceptor components with the new high-strength, high-stiffness, high-strain to failure fibers; and to demonstrate which of several competing fabrication processes will provide repeatable components within the narrow statistical band needed to achieve technology insertion.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603173C	1270	0.6	0.8	0.8	2.0	2.0	2.0	0
	Total	0.6	0.8	0.8	2.0	2.0	2.0	0

BIOMEDICAL

BIOMEDICAL

MD.01.J00 ***Sustained Operations Enhancement Ensemble.*** This DTO will develop and adapt countermeasures for behavioral and physiological degradation caused by demands of sustained operation. Efforts will ensure that personnel will perform optimally in all environmental/operational extremes. Technological barriers include unknown interactions between pharmacological aids and other fielded drugs, an incomplete understanding of sleep physiology and the purpose of restorative sleep, and the development of dry electrode technology for noninvasive brain activity monitoring. By FY97, the program will provide guidance to develop an operational doctrine for pharmacological intervention to counter fatigue and sleep loss in military operations, improving the performance of personnel experiencing 72 hours without sleep by 20%. The FY99 goal is to provide a joint guidance for commanders, integrating knowledge of sleep loss, melatonin, shift work schedules, and performance decrements for conducting rapid deployments and sustained operations to reduce performance decrements by 25%. By FY02, the program will field a ruggedized, noninvasive alertness monitoring system for integrated air defense personnel.

Fatigue during extended contingency operations limits unit operational effectiveness and jeopardizes safety. Stress and fatigue are the primary or secondary cause of a large number of casualties. These factors can become the primary agents of mission failure. For example, 26% of major nonejection accidents in combat aircraft are attributable to failures of attention, and 15% are attributable to fatigue and circadian phenomena. Implementation will reduce accidents involving loss of duty days in active duty personnel involved in continuous operations by 15%.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	878 & 879	4.4	4.8	6.1	6.0	6.1	6.1	0
0603002A	819	0	0	0	0.2	0.2	0.5	0
0602233N		1.0	1.3	1.4	1.5	1.6	1.2	0
0603706N	M00096	0.7	0.8	0.9	1.0	1.0	1.4	0
0602202F	7184	0.5	0.5	0.5	0	0	0	0
	Total	6.6	7.4	8.9	8.7	8.9	9.2	0

MD.02.J00 ***Vaccines for Prevention of Malaria.*** By FY98, this program will demonstrate the feasibility of a DNA *Plasmodium falciparum* vaccine in preclinical studies. The FY00 goal is to complete all preclinical trials required to begin testing in human volunteers of a multiantigen multistage malaria vaccination process to prevent *P. falciparum* infection in 80% of immunized troops. By FY03, the program will begin testing in human volunteers a vaccination process to prevent 80% of immunized troops against both *P. falciparum* and *P. vivax* malaria.

Malaria is a medical threat to U.S. troops deployed to the tropical regions of Africa, Asia, South and Central America, and the Pacific. In Vietnam, infection rates reached 600 per 1,000 soldiers per year. Current control of malaria depends on prophylactic drugs. An effective vaccine will overcome parasite resistance and reduce the need for troops to take antimalarial drugs. A successful vaccine will overcome the technological barrier of interrupting stages of the parasite exposed to the immune system for a brief period of time.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	870	2.3	2.3	2.4	2.3	2.5	3.0	3.1
0603002A	810	1.7	1.5	1.5	1.5	1.6	1.8	1.7
	Total	4.0	3.8	3.9	3.8	4.1	4.8	4.8

MD.03.J00 ***Far-Forward Assessment and Treatment for Blood Loss; Development of Blood Products and Resuscitation Fluids.*** By FY98, this program will demonstrate safety and efficacy sufficient to justify transition to advanced development of a field-portable infusion-fluid warming device. FY99 goals are to double the storage life of liquid whole blood and blood products and to define optimum resuscitation perfusion pressures, volumes, and temperatures for early versus delayed field resuscitation of hemorrhage, improving survival by 10%. By FY01, the program will demonstrate and complete evaluation of candidate products for local hemostasis to keep 20% of hemorrhages from becoming life-threatening. Technology barriers addressed include instability of red blood cells during prolonged storage; an inadequate understanding of the effects of fluid resuscitation on physiological status and outcome; and simple, rapid, reliable materials and methods to stop arterial bleeding.

In the pre-hospital setting of modern battlefields, where 50% of combat deaths are due to hemorrhage, a significant number of lives can be saved by stopping hemorrhage from becoming life-threatening, or by quickly, efficiently, and effectively resuscitating victims following massive blood loss. This DTO develops products which will allow field medics to accomplish both of these goals.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	874	1.5	1.4	1.2	1.3	1.3	0	0
0603002A	840	0.8	0.8	0.8	0.8	0.8	0	0
0602233N		0.9	0.9	0.9	1.0	1.0	0	0
0603706N	M00095	4.9	5.1	5.2	5.4	5.6	0	0
	Total	8.1	8.2	8.1	8.5	8.7	0	0

MD.04.J00 ***Medical Countermeasures for Botulinum Toxin.*** This DTO will develop medical countermeasures against the biological warfare (BW) threat of botulinum toxin. Specifically, it will develop a second-generation recombinant vaccine to protect a minimum of 80% of animals from lethal aerosol challenge. FDA licensure of a second-generation vaccine to protect a minimum of 90% of immunized personnel against an aerosol challenge, provide protection against all serotypes, and induce minimum reactogenicity in immunized soldiers will be sought in FY98. Major technical challenges include developing appropriate model systems for investigational purposes, generating of immune responses to small molecules, and determining expression vectors for recombinant products.

Botulinum toxin is a validated BW threat of high priority. It is a potent protein toxin, highly lethal by aerosol exposure. There are seven distinct serotypes of toxin. The present toxoid vaccine (which includes five serotypes) is in short supply, and there are no drugs available for treatment of botulism poisoning. This effort will lead to the development of a new-generation, recombinant-derived vaccine and drugs effective in the treatment of poisoning. These countermeasures will reduce the BW threat and enhance the operational flexibility of U.S. forces.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	TB2	1.5	0	0	0	0	0	0
0603384BP	TB3	1.2	1.8	0	0	0	0	0
	Total	2.7	1.8	0	0	0	0	0

MD.05.J00 ***Chemical Agent Prophylaxes.*** By FY97, this program will demonstrate the feasibility of a reactive/catalytic scavenger pretreatment effective against chemical agents. The FY99 goal is to demonstrate safety and efficacy sufficient to make a product development decision for transition of a reactive/catalytic scavenger pretreatment to reduce chemical agent toxicity without operationally significant physiological or psychological side effects. Major technical challenges include developing effective pretreatments completely devoid of side effects, developing suitable animal models, extrapolating efficacy test results from animals to man, and generating immune responses to small molecules.

Nerve agents are a validated threat to U.S. forces. The proposed work will develop a pretreatment based on genetically engineered human cholinesterase to provide extended protection against a wide spectrum of nerve agents without performance-reducing side effects or the need for extensive post-exposure therapy. Improved prophylaxis for chemical warfare agents deters their use by the enemy and increases the capability of U.S. forces and allies to sustain operational tempo and provide full dimension protection.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	TC2	1.3	1.1	0.9	0	0	0	0
0603384BP	TC3	1.0	1.2	1.3	0	0	0	0
	Total	2.3	2.3	2.2	0	0	0	0

MD.06.J00 ***Prevention of Diarrheal Diseases***. This DTO will complete all preclinical trials required to begin tests in human volunteers of candidate vaccines to protect 80% of troops from dysentery and profuse watery diarrhea. These vaccines include a *Shigella sonnei* vaccine by FY97; a modified live *Campylobacter* vaccine by FY99; a *Shigella flexneri* vaccine by FY99; and a *Shigella dysenteriae* and an Enterotoxigenic *Escherichia coli* (ETEC) vaccine by FY01. By FY03, the program will assess the feasibility of a combined vaccine to prevent several key enteric pathogens from causing diarrhea.

Diarrhea affects 20–30% of soldiers deployed OCONUS. ETEC caused 55% of diarrhea cases during Operation Desert Storm/Shield (ODS/S) and was a major problem in Somalia. *Shigella* caused 19% of the cases of acute diarrhea during ODS/S, and *Campylobacter* caused 60% of diarrheal illnesses during Cobra Gold. Effective vaccines will overcome antibiotic resistance, enhance strategic mobility, and reduce medical logistics requirements. Success will overcome the technology barrier of enhancing the immune response at the mucosal surface.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	870	1.5	1.5	1.7	1.5	1.9	1.0	1.2
0603002A	810	1.3	1.1	1.2	1.2	1.2	0.8	0.8
	Total	2.8	2.6	2.9	2.7	3.1	1.8	2.0

MD.07.J00 ***Medical Countermeasures for Vesicant Agents.*** By FY97, this DTO will demonstrate an effective vesicant countermeasure as a treatment in an animal model. The FY00 goal is to demonstrate safety and efficacy of a candidate medical countermeasure sufficient to make a product development transition decision. Major technical challenges include developing effective pretreatments completely devoid of side effects, developing suitable animal models, and extrapolating efficacy test results from animals to man.

Vesicant chemical agents, such as sulfur mustard, are a significant threat to U.S. forces. There are no specific medical countermeasures for blister agents. Medical management of the injuries these agents inflict presently depends on immediate decontamination followed by conventional treatment of the resulting blisters or burns, rather than on specifically designed pretreatment/treatment. This work will yield a vesicant agent countermeasure that will prevent or decrease the severity of injuries, substantially reducing casualties among exposed soldiers and thus the medical logistic burden. Effective countermeasures to the vesicant chemical agents would deter their use and enhance capabilities of U.S. forces to sustain operational tempo.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	TC2	4.0	3.8	3.6	3.4	0	0	0
0603384BP	TC3	4.6	5.1	5.2	5.5	0	0	0
	Total	8.6	8.9	8.8	8.9	0	0	0

MD.08.J00 ***Laser Bioeffects Countermeasures.*** The goal is to mitigate the impact of low-level, laser-induced glare on visually mediated human performance. By FY97, the program will define the impact of low-level, laser irradiation-produced visual glare on visual performance; by FY98, validate models of laser-induced contrast reduction that include effects of transparencies; by FY99, integrate the information into tri-service bioeffects threat analysis systems and mission planning systems (version 1.0) to achieve full integration of recommendations regarding exposure limits and risks to military personnel from laser threats; by FY01, develop a directed-energy warfare server for laser bioeffects to use on the DoD distributed interactive simulation network for training; and by FY03, complete field evaluation of nonlinear optical materials for frequency-agile laser eye protection and provide data to validate personnel protection requirements for advanced materials. The payoffs will be laser safety standards based on operational combat performance measures, as well as information warfare systems for laser threats. The technology barriers include developing and validating computer models of visual performance and laser bioeffects. The primary metric is the on-schedule delivery of the first DoD laser bioeffects threat analysis system to intelligence officers and operational planners in FY99.

The ability of even low-power lasers to damage the eye poses an especially relevant threat to military operations. Aviators are acutely vulnerable to laser light effects because of the time-critical nature of many visually guided tasks. The loss of visual sensitivity for as little as a few seconds during a crucial phase in a maneuver can seriously compromise mission readiness.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	878	1.2	1.3	1.5	1.5	1.5	1.5	1.5
0602233N		0.7	0.8	0.9	0.9	1.0	1.1	1.1
0603706N	M00095	0.5	0.6	0.6	0.7	0.7	1.0	1.0
0602202F	7757	0.9	0.9	0.9	0.9	1.0	1.0	1.0
0603231F	2830	0.5	0.7	0.7	0.8	0.7	0.6	0.6
	Total	3.8	4.3	4.6	4.8	4.9	5.2	5.2

MD.09.J00 ***Advanced Medical Technology—Advanced Field Medical Support in Forward Combat Areas.*** This DTO executes a combined operational medicine and combat casualty care effort, starting in FY97, to develop and test warfighter physiological status monitoring technologies (biophysical and biochemical smart sensors and information fusion) and models to assess and predict the readiness status of soldiers. This will provide the basis for casualty avoidance and near-real-time casualty detection, provide physiologic status of combat casualties, and support rapid far-forward casualty care. Casualty prevention is accomplished through command consultation on such factors as sleep loss, energy expenditure, environmental stress, and performance impairment, which signal an impending casualty. Casualty detection is obtained through direct or computer-aided assessment of state changes in monitored measures. Casualty care will be enhanced by developing and testing computer-assisted monitoring, diagnoses, and medical decision assist support software and hardware technologies now part of Warrior Medic and Echelon I+ Telemedicine. Portable and hand-held medical imaging devices, such as ultrasound, will be developed by FY99 to assess internal injuries either directly on the battlefield or by rear-echelon telemedicine. Casualty stabilization and evacuation will be accomplished by developing and testing an intensive care support evacuation platform (LSTAT). Using virtual reality technology for combat care training, acute trauma (limb trauma simulator) and battlefield casualty triage (simulated corpsmen-SIMCOR) will be demonstrated by FY98 to reduce the use of animal models and incorporate medicine into the virtual battlefield. The goals of this program are a 25% reduction in total casualties, a 10% reduction of killed-in-action casualties, and a 33% reduction in the personnel evacuation burden due to nondisease battle injuries. Technical barriers include modeling clinical judgment to inform command consultation, and advanced biosensor technologies for noninvasive biochemical assessments of metabolism and stress. These arise from the transition of this new technology into a broader warfighter population, including mounted and aviation battlefield operating systems, as well as from the integration of preventive monitoring, casualty care, and evacuation technologies into a seamless system. This system will be fielded for integrated system evaluation in FY03.

This initiative provides commanders and health care providers with vital intelligence concerning medical aspects of the operational condition of forces, supplementing the integrated battlefield sensor montage. It also includes a medical equipment ensemble capable of projecting elements of sophisticated medical monitoring and treatment to the farthest ends of the battlefield.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	874, 878 & 879	4.2	4.5	4.5	4.3	4.5	4.7	4.7
0603002A	819 & 840	0.6	0.5	0.6	0.6	0.6	0.7	0.7
0603706N	M00096	0.3	0.6	0.8	1.0	1.2	1.2	1.3
0602712E	MPT-07	14.4	7.9	2.7	0	0	0	0
	Total	19.5	13.5	8.6	5.9	6.3	6.6	6.7

MD.10.J00 ***Toxic Hazards Evaluation Tools.*** This DTO will develop the technology to identify and analyze the diverse toxicological exposures of deployed troops in the field and aboard military vessels. By FY97, the program will demonstrate an improved toxicity test battery for assessing neurological and performance consequences of toxic exposures, to allow battlefield commanders to realistically assess the mission performance degradation consequent to such exposures. FY98 goals are to develop and initiate deployment of a new family of precise real-time hazard detection methods for a wide range of chemical stressors; and field an intrinsic cellular toxicity test battery to rapidly evaluate materials under consideration for incorporation into new weapon systems for toxicological hazards that would restrict or delay system deployment. By FY99, the program will field an integrated target organ dose estimation tool (ITODET) employing pharmacokinetic models, in conjunction with chemical fate and transport models, to determine target organ doses of operationally relevant occupational and environmental hazards for personnel in the field. Data provided by ITODET will be used by field commanders to make operational decisions in the face of chemical hazards. By FY02, a Molecular Toxicity Assessment System (MTAS) will be fielded to evaluate health risks, set operational exposure standards, and support testing of new materials. MTAS will be used in systems acquisition and environmental impact assessments and will reduce toxicity testing in animals.

Sources of toxic exposure in the operational environment are numerous and diverse. They include solvents and fuels, smoke produced by fires, complex chemical interactions from occupational exposure, and environmental warfare effects. Current capabilities for operational hazard evaluations involve time-consuming and expensive animal toxicity studies. New, rapid, and less expensive toxic hazard evaluation tools are needed to protect the warfighter from the thousands of hazardous substances associated with and generated by military operations. These tools also will yield essential knowledge of biomarkers to be used in the development of chemical and biological agent detectors and exposure monitors providing real-time field data to support operational decisions. Added benefits of these tools include immediate application to base remediation projects, significant reductions in whole animal toxicity testing, and a more timely process to establish operational exposure standards.

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		CAPT Macys NEHC DSN 864-5565	LTC Landry CHPPM-DSA DSN 923-7403

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	878 & 879	0.6	0.8	0.8	1.0	1.2	1.2	0
0602233N		0.5	0.6	0.6	0.7	0.7	0.8	0
0603706N	M00096 & M00095	0.8	0.8	0.8	0.8	0.9	0.9	0
0602202F	7757	1.3	1.2	1.2	1.2	1.3	1.3	0
	Total	3.2	3.4	3.4	3.7	4.1	4.2	0

MD.11.J00 ***Far-Forward Assessment, Treatment, and Management of Combat Trauma and Severe Hemorrhage and Sequelae.*** By FY00, this initiative will demonstrate safety and efficacy sufficient to accelerate product development of a pharmacologic intervention to preclude or reduce ischemia/reperfusion injury by 20% or greater. By FY03, demonstrated safety and efficacy will be sufficient to accelerate development of pharmacologic or device interventions to lower tissue oxygen requirements by 20%. Such products will be capable of reducing or preventing development of secondary injuries from combat trauma and massive hemorrhage, particularly brain and spinal cord injury, by 20%. Technology barriers addressed include inadequate understanding of the efficacy and safety of pharmacologic interventions for ischemia-reperfusion injury; inadequate understanding of the mechanisms of brain and spinal cord injury that occur secondarily to mechanical trauma; and the difficulty of rapidly altering core body temperature in austere environments.

Many combat deaths can be directly attributed to cellular and metabolic derangements following massive hemorrhage or trauma. Often, these cellular or metabolic events begin as cascades manifested days later as severe complications (secondary brain injury, multiple organ failure, etc.) or death. Consequently, products developed under this effort are directed at preventing these delayed complications through more effective initial treatments, drugs, devices, etc. These efforts will result in products which will save lives now lost to combat trauma and severe hemorrhage. This effort will identify, evaluate, and transition initial trauma treatments or products to more effectively abolish or attenuate complications arising from combat trauma.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	874	7.6	7.2	6.5	6.6	6.5	6.7	6.8
0603002A	840	0.8	0.8	0.8	0.8	0.8	0.9	1.0
0602233N		0.9	0.9	0.9	0.9	1.0	1.0	1.1
0603706N	M00095	2.0	2.0	2.1	2.2	2.2	2.3	2.4
	Total	11.3	10.9	10.3	10.5	10.5	10.9	11.3

MD.12.J00 ***Antiparasitic Drug Program.*** The objective is to complete all preclinical trials required to begin tests in human volunteers of candidate antiparasitic drugs to prevent or treat 80% of infections caused by malaria or leishmania parasites. These drugs include arteether (treatment of severe drug resistant malaria), by FY97; topical paromomycin/gentamicin (cutaneous leishmaniasis treatment), by FY97; atovoquone-proguanil (malaria prophylaxis), by FY97; artelinic acid (malaria treatment), by FY01; acridine analog (malaria prophylaxis), by FY01; and pyridine methanol, by FY03.

Malaria is a medical threat to U.S. troops deployed to the tropical regions of Africa, Asia, South and Central America, and the Pacific. Cutaneous and visceral leishmaniasis were the most common chronic infections in Operation Desert Shield/Storm veterans. Novel antiparasitic drugs are required as replacements for standard drugs that have lost antiparasitic effectiveness. Success will depend on solving the technology barrier of overcoming drug resistance.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602787A	870	1.0	0.8	0.8	0.7	1.0	1.0	1.0
0603002A	810	3.3	3.0	3.1	3.0	3.0	3.5	3.3
	Total	4.3	3.8	3.9	3.7	4.0	4.5	4.3

MD.13.J00 ***Medical Countermeasures for Staphylococcal Enterotoxin B.*** This DTO develops medical countermeasures against the biological warfare (BW) threat of staphylococcal enterotoxin B (SEB) toxin. The goal is to develop a vaccine that meets requirements for 80% or better protection against lethal aerosol challenge in animal studies. The FY00 goal is to make a product development decision to submit an application for licensure to the FDA on behalf of a second-generation (recombinant) SEB vaccine. This vaccine will protect 90% of immunized personnel against both a lethal and an incapacitating aerosol challenge of SEB. Major technical challenges include developing appropriate model systems for investigational purposes, generating immune responses to small molecules, and determinating expression vectors for recombinant products.

SEB is a validated BW threat of high priority. It is an incapacitating and potentially lethal biological toxin that can be delivered by either aerosol or oral routes to a target population. Since SEB is also a naturally occurring product of the common bacterium *Staphylococcus aureus*, the bacterium or toxin can be a serious problem on the battlefield, causing sepsis (blood poisoning) and shock. Deliberate exposure of troops to SEB delivered as a BW agent would significantly reduce mission effectiveness. The development of a vaccine against SEB reduces this threat for the soldier, deters its use as a BW agent, and enhances strategic mobility.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	TB2	1.7	1.6	1.4	0	0	0	0
0603384BP	TB3	1.6	2.3	2.7	1.8	0	0	0
	Total	3.3	3.9	4.1	1.8	0	0	0

MD.14.J00 ***Medical Countermeasures for Yersinia pestis.*** This DTO develops medical countermeasures against the biological warfare (BW) threat of *Yersinia pestis*, the causative agent of plague. By FY98, the program will make a product development decision about a vaccine that will protect 90% of immunized personnel against an aerosol challenge of *Yersinia pestis* and induces minimum reactogenicity in immunized soldiers. New-generation antibiotics will be evaluated for their effectiveness against both bubonic and pneumonic plagues. Major technical challenges include developing appropriate model systems for investigational purposes and determining expression vectors for recombinant products.

Plague caused by *Y. pestis* is a validated BW threat of high priority. Bubonic and pneumonic plagues caused by *Y. pestis* are serious BW threats to the soldier. Plague is a disease of rapid onset and high death rates. The effects of aerosol exposure could be further exacerbated by secondary human-to-human spread from infected personnel. The current plague vaccine is too reactogenic, induces immunity that is short-lived, requires multiple immunizations, and is of unproven efficacy against an aerosol exposure. A new vaccine should protect against parenteral and aerosol exposure, have long-lasting immunity, require only one immunization, and protect against the three different forms of the disease. The combination of prophylactic (vaccine) and therapeutic (antibiotic) treatments will afford the soldier the greatest degree of protection against infection with plague, deter its use as a BW agent, and increase the strategic mobility of U.S. forces.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	TB2	0.9	0.8	0	0	0	0	0
0603384BP	TB3	0.9	1.1	0	0	0	0	0
	Total	1.8	1.9	0	0	0	0	0

MD.15.J00 ***Medical Countermeasures for Encephalomyelitis Viruses.*** This DTO develops medical countermeasures against the biological warfare (BW) threat of the equine encephalomyelitis viruses, a group of viruses that cause disorientation, convulsions, paralysis, and death. Vaccines will protect a minimum of 90% of the immunized population against an aerosol challenge of the virus and will induce minimum reactogenicity in soldiers when immunized. By FY97, a product development decision will be made regarding an improved vaccine effective against Venezuelan equine encephalitis (VEE) strains 1 A/B and C. By FY98, the program will construct analogous vaccines for Eastern equine encephalitis (EEE) and Western equine encephalitis (WEE). The FY00 goal is to make a product development decision about a vaccine effective against all pathogenic strains of VEE virus (i.e., a multivalent vaccine). Major technical challenges include developing appropriate model systems for investigational purposes, generating immune responses to small molecules, and determining expression vectors for recombinant products.

Encephalomyelitis viruses are important BW threats because of aerosol infectivity and relative stability. Clinical illness associated with VEE, EEE, and WEE includes headache, fever, chills, nausea, vomiting, mental confusion, sleepiness, and sometimes seizures and other neurological signs and symptoms. Mosquito vectors normally transmit these alphaviruses to birds, horses, and humans; however, alphaviruses are very stable when freeze-dried and have the potential to be used as a biological weapon. Safe and effective vaccines are needed to protect soldiers. Current vaccines for alphaviruses causing encephalomyelitis are inadequate. Improved vaccines would decrease the threat of BW and enhance strategic mobility.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602384BP	TB2	0.4	0.4	0	0	0	0	0
0603384BP	TB3	0.8	0.8	0.8	0.7	0	0	0
	Total	1.2	1.2	0.8	0.7	0	0	0

SENSORS, ELECTRONICS AND BATTLESPACE ENVIRONMENT

SENSORS, ELECTRONICS AND BATTLESPACE ENVIRONMENT

SE.01.02 ***Low-Cost Electronically Scanned Antennas***. Overcoming the challenge of developing low-cost electronically scanned antennas (ESAs) for multiple platforms and applications will allow the warfighter to benefit from the acquisition of a significantly larger number of more capable systems in a time of declining resources. In FY97, the Army will be evaluating and developing scanning strategies for an antenna based on Rotman lens technology. In FY98, the Rotman lens design will be finalized, assembled, and tested. The program goal is to realize acceptable performance of an ESA at less than 50% of the current cost. The current antenna integration includes three parts: the Rotman lens, an Endfire "Vivaldi" notches aperture array, and a switch control matrix. The performance goals for this approach are a horizontally polarized antenna with an operating frequency range from 6 to 18 GHz, an azimuth field of view from ±45 deg, an antenna gain of 30 dB, and beamwidths of 2-deg azimuth and 6-deg elevation.

The Navy is investigating two candidate lens technologies (ferroelectric and diode) for reducing the cost and weight of X-band phased arrays, while still maintaining the required performance. In FY98, a 5" x 5" ferroelectric lens will be built and tested. Specific technology goals are 3-GHz bandwidth and an insertion loss of less than 1.5 dB for a single lens. Goals for this technology program are to achieve mission acceptable performance (platform dependent) at a procurement cost of less than 70% of current high-performance active element array costs. Cost savings goals are based on ESA capability with few or no transmit/receive modules. In the diode lens approach, the necessary phase gradient is introduced by turning diode strips located between parallel plates on and off to change the apparent dielectric constant. In FY98, a 4" x 8" diode lens will be tested as a radar with slotted array. Specific technology goals are 1-GHz bandwidth, insertion loss of less then 1.0 dB for the lens, and sidelobe degradation of less than 2 dB.

The Radar Systems Aperture Technology is an Air Force program for demonstrating technologies to reduce radar systems cost by 40% and improve radar systems reliability by 40%, while maintaining or improving overall system performance. Technologies being developed include continuous transverse stub (CTS) antennas made of voltage-variable dielectric material. CTS antennas provide ESA performance at half the cost of active ESAs. A laboratory demonstration of the CTS antenna will be conducted in FY98.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602232N		1.7	1.7	0	0	0	0	0
0603203F	665A	1.7	0	0	0	0	0	0
	Total	3.4	1.7	0	0	0	0	0

SE.02.01 ***Foliage Penetration Detection Algorithm Demonstration***. Adversary forces have utilized the tactic of "hiding" under tree canopies since the Vietnam era. Current fielded radar systems, operating at X-band (8–12 GHz) have little or no capability to detect and discriminate targets concealed in foliage. Recent developments have led to a better understanding of natural background clutter phenomenology such as trees relative to man-made object discriminants. This knowledge base has enabled sensor, signal processor, and signal detection and discrimination algorithm developments tailored to concealed target detection. This DTO will conduct experiments using low-frequency synthetic aperture radar sensors to yield statistics to support development of foliage penetration radar system technology and requisite target detection and discrimination algorithms. Initial findings in this program indicate that the radar signal processing algorithm derived from this DTO will reliably provide a 90% detection probability with less than 0.1 false alarm per square kilometer against time-critical targets concealed under foliage. Removal of the safe haven of tree cover for threat forces is a significant improvement in warfighting capability.

Milestones include, in FY 97, boom SAR data collection experiments, and collection of 25 SAR strip maps with 280 target scenarios and 12 ISAR images using four tactical vehicles to support analysis of target/clutter discrimination techniques for automatic target detection; and, in FY98, ground demonstration of real-time target detection algorithms having a 90% detection probability with less than 0.1 false alarm per square kilometer of targets concealed under foliage.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603203F	665A	1.5	0.6	0	0	0	0	0
0602120A	AH16	0.3	0	0	0	0	0	0
	Total	1.8	0.6	0	0	0	0	0

SE.03.01 ***Enhanced Moving Target Detection Development.*** Accomplishment of this major technical challenge's objective will provide the warfighter with information superiority of the battlespace in any environment. This requires signal processing techniques which challenge the state of the art. This DTO addresses identified needs for performance upgrades to both Air Force and Navy AEW radar sensors and the development of a lightweight SAR/MTI radar for tactical Army UAV platforms. One key objective is to develop and incorporate advanced space-time adaptive processing (STAP) algorithms into existing look-down airborne sensors. STAP developments to date have demonstrated clutter suppression of greater than 30 dB beyond that achievable with current airborne radar systems. STAP has further demonstrated the ability to selectively steer deep nulls of 70 dB in the host radar antenna pattern, thereby minimizing the effects of high-power main beam jamming signals. Investigation of antenna augmentation will be accomplished and completed by FY98. The result of this DTO will be a STAP capability ready for implementation for E–3A and a flying testbed on a modified P–3 in FY99. Another key objective is the Army's development of a low-cost, lightweight MTI/SAR payload for tactical UAVs to enhance reconnaissance, surveillance, battle damage assessment, and targeting of moving and stationary targets. Technologies being developed include advanced signal processing, encompassing improvements to Longbow algorithms, wavelets, SAR image formation from very slow platforms, and use of commercial-off-the-shelf signal processing hardware.

Milestones include, in FY97, demonstration of the AEW Radar Model incorporating STAP against 55-dB clutter data; in FY98, extension to height findings of targets less than 500 ft; in FY99, STAP augmentation showing 15-dB improvement J Hook clutter suppression and Airborne STAP testbed; and, in FY00, demonstration of low-cost, lightweight MTI/SAR with 70% probability of detection and false alarm rate of two targets/min at ranges greater than 12 km for MTI and 5 km for SAR.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602232N		0.5	0.6	0.6	0	0	0	0
0603238N	R2145	0.4	1.0	1.0	0	0	0	0
0602702F	4506	0.1	1.5	1.5	0	0	0	0
0603789F	4072	0	1.2	1.2	0	0	0	0
0602120A	AH16	2.0	1.7	0.3	0	0	0	0
0603772A	D243	1.0	3.9	4.9	6.7	0	0	0
	Total	4.0	9.9	9.5	6.7	0	0	0

SE.04.02 ***High-Frequency Surface Wave Radar Shipboard Demonstration***. This ATD is aimed at demonstrating over-the-horizon detection of low-flying antiship missiles by a shipboard radar operating in the high-frequency (HF) band near 20 MHz. Detection and tracking of the targets will exploit sea-surface hugging features of surface wave propagation. The High-Frequency Surface Wave Radar (HFSWR) Shipboard Demonstration will provide critical early warning (30 seconds for a M2.0 target) of missile attack and cueing of weapon engagement radars. Critical issues to be addressed by the demonstration include compatibility of the radar with other shipboard HF systems and the effects of the complex shipboard scattering environment on target detection and tracking. Target transitions include both forward-fit (CVN–76 and SC–21) and back-fit (LSD–41 class, and other ships slated for the self-defense system). The HFSWR is currently under development for testing on the Self-Defense Test Ship (SDTS) and LSD–41 class ship. At-sea testing will begin in FY97 and extend into FY98. Performance goals include detection of a supersonic sea skimming missile at two-and-a-half times the range currently achievable with a microwave radar, with better than a 1-degree azimuth tracking accuracy. Applications of the HFSWR to theater ballistic missile defense are also being pursued against target-of-opportunity missile launches during the at-sea testing period. Supporting work on the feasibility of a bistatic or multistatic configuration of the HFSWR is being conducted with 6.2 funding from ONR.

Milestones include, in FY97, detection and tracking of BQM–74 drone at 18 nmi by system installed on Self-Defense Test Ship, and RFI and EMI testing on LSD–41; and, in FY98, detection and tracking of BQM–74 drone at 20 nmi by system installed on LSD–41.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602232N		0.2	0.4	0	0	0	0	0
0603792N	R1889	5.5	5.5	0	0	0	0	0
	Total	5.7	5.9	0	0	0	0	0

SE.05.01 ***Automatic Radar Periscope Detection and Discrimination***. With the end of the cold war, Navy mission needs have shifted from blue (open ocean) to brown (littoral) waters. Regional conflict involvement requires protection of fleet units from submarine torpedo attack in shallow water, where acoustic sensors perform poorly. The Third World diesel-electric submarine threat provides significant periscope detection opportunities. This project demonstrates advanced radar technology for surface and airborne radars to automatically detect exposed periscopes in the presence of sea clutter and small targets and debris found in the littoral environment. The Navy's current periscope detection airborne radar, the AN/APS–137, is the basis for this development and will be enhanced by developing and integrating automated detection and discrimination technology, along with automatic target classifier/recognition processing, to enable rapid distinction of periscopes in the complex clutter (sea clutter, floating objects) typical of littoral operating environments. Initial technical performance will be assessed in a Shore Test in FY97. Shipboard and airborne technical and fleet performance assessments will be conducted in FY98 and FY99, respectively. The program will complete in FY00 with final documentation of baseline performance. The primary goal is to demonstrate a greater than 50% probability of detection with less than 5 seconds of exposure time with a false declaration rate of less than one per 24-hour period.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603747N		12.8	9.0	0	0	0	0	0
	Total	12.8	9.0	0	0	0	0	0

SE.06.01 ***Multifunction Electro-Optical Sensors and Signal Processing***. The ability to acquire threat targets that are increasingly stealthy in a wide (360 deg) panorama under task loading associated with increased battle tempo necessitates improvements in high-speed processing of EO-generated signals. This DTO addresses tri-service operational needs for improved algorithm performance and efficiency in passive IRST and staring sensors to support target classification through extraction of temporal, spectral, and polarmetric data. The program undertakes development of highly stabilized IRST and staring sensing capabilities for over-the-horizon detection and precision tracking of theater ballistic missiles at ranges out to 500 km, horizon detection (13 nmi) of cruise missiles for ship self-defense and detection, precision tracking of threat aircraft from ground combat vehicles, and air-to-air target acquisition. Current IRST signal processing algorithms use spatial discrimination, which limits sensitivity and increases false alarms in highly cluttered backgrounds. Recent technology developments in large-area, highly uniform, IRFPAs has necessitated innovative signal processing to capitalize on the capability for both IRST and staring sensors operated in forward looking models.

Multidimensional processing algorithms to fully exploit the spatial, spectral, and temporal characteristics of a dynamic target relative to natural background clutter are being developed. These algorithms will be completed and mapped into a COTS parallel signal processor for laboratory test in FY97. The initial transition for this processor is to the PEO for theater air defense in FY98 for integration with the Shipboard Two-Color IRST. This hardware will undergo extensive at-sea operational evaluation during FY98 and FY99. This DTO demonstrates a multifunction staring sensor suite that provides ground vehicles, amphibious assault vehicles, and surface ships with a compact affordable sensor suite for long-range noncooperative target ID, mortar/sniper fire location, and air defense against low-signature UAVs and long-range helicopters. By FY00, the goal is to integrate FLIR, multifunction laser, and acoustic components and demonstrate search, acquisition, and noncooperative identification. The FY01 goal is to integrate weapons/fire location processing and demonstrate the capability to detect and locate mortar/sniper fire. Warfighting capability payoffs are in passive covert sensing for threat target detection, warning, and situational awareness including on-the-move ground air defense vehicles.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602232N		3.5	2.8	0	0	0	0	0
0602702E	TT-06	7.0	5.2	6.0	10.6	7.0	0	0
0602712E	MPT-07	4.6	5.4	2.9	0	0	0	0
0603710A	DK70	0	6.3	9.7	9.6	9.6	0	0
	Total	15.1	19.7	18.6	20.2	16.6	0	0

SE.07.02 ***Advanced Pilotage***. To take the fight to the enemy without detection, the warfighter must enter and exit hostile areas at night and in adverse weather, using evasive maneuvers. The battle cannot be won until safe and survivable pilotage and navigation is first accomplished by all air and surface craft. This DTO develops and demonstrates advanced sensor technology for night/adverse weather pilotage/navigation requirements. Included will be all aspect viewing via fixed-mounted sensors providing full sphere coverage, large staring arrays, and multispectral image fusion. By FY97, the program will develop and flight test an image intensified sensor and fast IR focal plane array for a wide-field-of-view thermal sensor, demonstrating a 50% increase in obstacle recognition range in the poorest weather and in the darkest nights, a 25% increase in the instantaneous field of vision, and a decrease in the required number of training flight hours for "low time" aviators by 20%. By FY98, the goal is to demonstrate an integrated, wide-field-of-view pilotage/navigation sensor and display suite with image fusion. Image fusion combines the most salient features from the complementary FLIR and image intensified sensor imagery to show a single, complete picture of the operating area on a helmet-mounted display. This project will demonstrate a 25% decrease in target detection time using fused imagery.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603710A	DK86	3.2	2.5	0	0	0	0	0
	Total S&T	3.2	2.5	0	0	0	0	0
0603800N*	D2209	5.0	4.9	0	0	0	0	0
	Total	8.2	7.4	0	0	0	0	0

*Non-S&T funds.

SE.08.01 ***Advanced Infrared Search and Track Systems***. To provide vigilance of threat missiles and aircraft over a wide field while maintaining a high degree of stealth requires a passive mode of operation. This DTO develops and demonstrates highly stabilized passive infrared search and track systems (IRSTs) sensing capabilities for over-the-horizon detection and precision tracking of TBMs and cruise missiles for ship self-defense, and sensors for detection and precision tracking of threat aircraft from ground combat vehicles.

In FY97, the Navy's shipboard two-color (3–5, 8–12) scanning IRST transitioned to PEO (TAD)'s E&MD IRST 6.4 program for at-sea performance characterization and operational effectiveness evaluation. The Navy is developing the next-generation step-stare IRST for fixed-wing aircraft detection and tracking of TBMs and cruise missiles. In FY98, the airborne step-stare IRST will be in carrier-based E–2C AEW aircraft for extensive operational utility evaluation. In FY98–99, BMDO will add an eye-safe ladar to the IRST to provide angle-angle-range precision tracking of TBMs for the joint U.S./Israeli UAV BPI program. In FY99, the step-stare surveillance IRST will transition to Naval Air Systems Command PMA–231 for engineering development.

The Army's Electronic Integrated Sensor Suite (EISS) Bradley Demonstrator is a technology demonstration program that directly supports Army air defense requirements. The objective of the Army program is to integrate passive sensors onto ground vehicles and demonstrate autonomous and continuous wide-area volume search, detection, tracking, and identification of low-flying threat aircraft. The cornerstone of EISS is the Advanced Air Defense Electro Optics Sensor. This is a two-color (3–5, 8–12) IRST that can detect and track up to 300 targets while continuously scanning. The EISS was successfully demonstrated in FY96 and also at ASCIET 96. In FY97, the EISS program will complete development of algorithms; they will be coded and installed into a high-performance parallel processor, and an on-the-move capability will be demonstrated through simulation. These IRST system developments will lead to significant increases in operational capabilities, providing the warfighter with a covert long-range surveillance, precision track, and cueing sensor not previously feasible.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603710A	DK87	1.3	0	0	0	0	0	0
0602232N		3.5	2.8	0	0	0	0	0
	Total	4.8	2.8	0	0	0	0	0

SE.09.02 ***Multifunction Laser***. During battle conditions, the warfighter must be able to accomplish multiple goals such as range finding, target designation, and identification with a minimum of equipment to maintain battle tempo. This DTO will develop and demonstrate a high-efficiency, compact, laser diode pumped, wavelength diverse laser source in the 0.26–12-micron spectral region, and system controller software for multifunctional applications. The laser source will be eye safe for most modes of operation including laser rangefinder, radar, and target profiling mode. A cooperative program (Nunn) with the Japanese for eye safe laser radar development will be closely coupled with this program. By FY97, the program will develop modules with multiple wavelength outputs from 0.26–12 microns for countermeasures (visible, near-infrared, mid-infrared), obstacle avoidance, biological agent detection, rangefinding, enhanced target recognition, and laser radar for integration with vehicle target acquisition sensors. The FY99 goal is to complete development of multi-application software and investigate a horizontal technology integration approach to multifunction and multi-application laser sources and demonstrate the capability of optical parametric oscillators to provide high-power laser shifts in the 2–5-micron regime.

Service/Agency POC

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Customer POC

PEO-Aviation,
PM-ASM, PEO-IEW
Dismounted BL,
Mounted BL,D&SA
BL, EELS BL

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602709A	DH95	1.2	1.4	1.6	0	0	0	0
0602232N		0.8	1.0	1.0	0	0	0	0
0603203F	6658	0.5	1.0	1.2	0	0	0	0
0602204F	2001	0.6	0.4	0.5	0	0	0	0
	Total	3.1	3.8	4.3	0	0	0	0

SE.13.02 ***Lightweight, Broadband, Variable-Depth Sonar.*** This DTO will develop and demonstrate a towed sonar system to reliably detect and classify small, very quiet, slow-moving submarines in the shallow-water littoral warfare environment to provide the surface ship platform with a critically needed warfighting capability. Lightweight, Broadband, Variable-Depth Sonar (LBVDS) will combine and apply three new technologies: broadband signal generation and processing, energy-dense transducer materials, and sparse receiver line arrays. Broadband waveforms will mitigate environmental effects. LBVDS is not focused on any specific range of water depths, but rather on all ocean environments characterized acoustically as being dominated by bottom and surface interactions leading to high levels of reverberation and mixed multipath propagation effects.

LBVDS will provide a 20–30-dB improvement in active sonar detection and classification against a low-Doppler, below-the-layer threat in shallow water. Detection ranges in the 12–15-nmi range, combined with a large probability of detection ($\approx$0.9) and a low false alarm rate (one per day), will allow the surface combatant to control an area of the ocean. This will permit the surface combatant to sail confidently into any waters to accomplish its primary mission. The increased detection ranges will reduce the visual targeting capability of threat submarines, diminishing the submarine torpedo threat. The LBVDS design recognizes that ASW, as a support function, must be accomplished with minimum time and resources. The system is designed to operate with minimal impact on the ship.

A broadband sonar with large time-bandwidth products (approximately 10,000) and good spatial (approximately 0.3 m) and Doppler (approximately 0.3 m/s) resolution is required to suppress reverberation and channel-fading effects that dominate shallow-water active acoustic returns. A variable-depth sonar is required to match the signal to the sound channel occupied by the target while reducing surface reverberation (greater than 10 dB) and damping projector motion. A lightweight (less than 1,500 kg) tow body is required for tactical handling considerations at sea. Transducer material development and selection will be completed by FY97. Sea trials to evaluate system issues and collect broad-bandwidth data will be conducted in FY97, FY98, and FY99. The control, transmit, receive, and handling subsystems will be designed, fabricated, and tested by FY00. System integration, at-sea demonstration, and final report will be completed by FY02.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603747N	R2142	10.2	13.9	16.2	14.6	9.1	3.0	0
	Total	10.2	13.9	16.2	14.6	9.1	3.0	0

SE.14.02 ***Multistatic Active ASW.*** This DTO will develop and demonstrate a multistatic ASW capability incorporating an open architecture, commercial off-the-shelf-based, on-board signal processor and an off-board, high-power, long-endurance, low-frequency acoustic source for use by surface ships, submarines, aircraft, and deployed distributed sensors. The trend in submarine construction is to ever quieter and more capable platforms. As this trend continues, passive sonars alone may not be capable of providing adequate detection margins; use of active sonars may be required to detect and localize threat submarines. One of the principal disadvantages of active sonar in the past has been the "beaconing" effect of shipborne acoustic sources. Recent science and technology developments hold the promise of avoiding this fatal flaw by utilizing a high-power, low-frequency, long-endurance acoustic source deployed off board the receiving ship or sensor platform. This initiative will bring together recent developments in high-power, low-frequency transducers, high-density electronics, high-energy thermal power systems, flywheel energy storage, acoustic modem communications, bistatic receivers and processors, and target detection, classification, and clutter reduction algorithms for demonstration and rapid transition to the fleet of an effective multistatic ASW capability.

The program will use a multistatic system to provide a 15–20-dB improvement over existing passive systems, increase detection ranges by a factor of 3 to 5, and increase area coverage by a factor of 10. It will provide pre-production models of a multistatic ASW system to the fleet within 3 years from program start, and support fleet evaluation for 2 years. Projector critical design review, processor selection, TB–29 and RDS–1 sea trials, and initial vulnerability assessment will be completed by FY97. Projector final design review and an over-the-side test of brass board units will be completed in FY98. Demonstration of a pre-prototype system on a naval combatant is planned for FY99. Support of combatant systems will be provided through FY00.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602314N		6.5	3.0	4.6	4.4	0	0	0
0603792N	R1889	0	4.9	5.1	4.6	0	0	0
0603763E	MRN-02	7.8	17.5	31.1	30.8	0	0	0
	Total	14.3	25.4	40.8	39.8	0	0	0

SE.15.01 ***Affordable High-Performance Towed Arrays.*** This DTO develops and delivers improved towed arrays for tactical submarine and surface ship operational testing. Towed arrays are the most effective sensor available for passive sonar detection of threat submarines at long ranges, with emphasis on detection of low-frequency radiated noise. This DTO addresses Navy requirements for improving the acoustic performance and lowering the cost of towed arrays, through advances such as multiline volumetric towed arrays, which provide significant apertures in all three dimensions, and all-optical array technology, which eliminates discrete ceramic hydrophones, complex telemetry, and much of the hand labor that drives up the cost of manufacturing current-generation towed arrays. Analysis of current and projected threat submarine signatures indicates a need for as much as a 10-dB increase in directivity index over current-generation TB–16 and TB–23 submarine-towed arrays, and comparable improvements for surface ship-towed arrays. Additionally, reductions in array per-element wet-end cost of 80–90% are needed to meet affordability goals. Per-line diameter reductions of 50% or more are also needed to minimize weight and volume impacts on the ship and handling systems.

For multiline towed arrays, near-term goals are to transition technology to PMS 425 for a short, three-line multiline array capable of being stored in the existing TB–16 flushing tube (FY97). Longer term goals are to demonstrate the feasibility of a high-gain multiline array of about seven lines with length equivalent to the existing TB–23, to demonstrate an active source array that can be towed with the receive array for acoustic communications and rapid target localization, and to demonstrate fully reconfigurable apertures. For all-optical arrays, the near-term goal is demonstration of thin-optical towed array (TOTA) technology using a Bragg grating-based multiplexing approach to achieve up to 80% reduction in per-element wet-end cost (FY97), and to demonstrate satisfactory acoustic performance of reduced-diameter arrays against flow-induced self noise (FY98). The longer term goal is demonstration of a new (classified) approach for constructing all-optical arrays with potential for greater than 90% reduction in per-channel cost, and inherent versatility for use over a very wide acoustic bandwidth (by FY00). Initial collaborations with PEO(USW) ASTO on high-gain multiline towed arrays, active adjunct, and fully reconfigurable arrays will begin in FY97, with transition of high-gain multiline technology to PEO (USW) planned for FY99.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602314N		4.5	3.9	3.4	2.0	0	0	0
0603792N	R1889	0	4.9	4.9	4.6	0	0	0
0603763E	MRN-02	1.9	0	0	0	0	0	0
	Total	6.4	8.8	8.3	6.6	0	0	0

SE.19.03 ***Affordable ATR via Rapid Design, Evaluation, and Simulation***. The objective of this DTO is to reduce the cost and development time for ATR systems including single and multisensor ATRs for land and air targets. The development and acquisition costs will be lowered by using algorithm development tools for integrated evaluation, software reuse, and seamless algorithm targeting of HPC architectures and embedded hardware. Technology advancements will be made in the areas of high-fidelity, real-time synthetic signature and scene simulation; image and performance evaluation metrics, standards, facilities, and tools; large, high-quality, ground-truthed, multisensor databases; algorithm development tools and environments; integrated design environments; and high-performance computing. These will build on Air Force and Army evaluation capabilities for MMW, SAR, and FLIR ATR algorithms, systems, and architectures. Standardized methodologies and databases will be integrated with industry and academia via the ATR Working Group. The major technology barrier is the development of validated synthetic signatures and scene simulation with sufficient fidelity to support ATR development. Successful completion of this effort will provide (1) "honest broker," rigorous evaluation of ATR algorithms and architectures for both comparative analysis and determination of whether user specifications are met and to feed back results to the developer to improve design and performance; (2) higher performance algorithms via mix/match of various institutions' algorithms in common environment; (3) rapid target insertion based on high-fidelity signature modeling to maintain ATR currency and for application to various theaters of operation; (4) controlled evaluation in various realistic environments via combination of simulation and well ground-truthed measured data; and (5) system-level virtual prototyping for rapid and affordable ATR development.

By FY97, the program will establish common image/signal databases, standardize evaluation metrics and procedures, imbed synthetic IR targets into synthetic backgrounds, and, using real and synthetic infrared imagery, establish the human/human-ATR performance baseline for wide sector search, and develop virtual prototype of an ATR for a tank cueing application.

FY98 goals are to establish a common performance database for ATR, incorporate ATR underpinnings results from the research community and, using real and synthetic SAR imagery, establish the human/human-ATR performance baseline for wide area search, and demonstrate middleware concept for reusable application software.

By FY99, the program will demonstrate real-time synthetic multispectral image generation to support distributed interactive simulations; and demonstrate 1–5-Hz synthetic IR scene generation with high fidelity to support ATR ID evaluation.

Service/Agency POC	Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602709A	DH95	8.0	8.3	8.5	0	0	0	0
0602204F	7629	1.3	1.3	1.3	0	0	0	0
0603203F	69DF	6.1	7.2	7.1	0	0	0	0
	Total	15.4	16.8	16.9	0	0	0	0

SE.20.01 ***ATR for Reconnaissance and Surveillance***. This DTO will provide the battlefield commander with enhanced situational awareness by fully exploiting the capability of reconnaissance/surveillance platforms. Currently, on the order of 70% of imagery collected is not screened due to the throughput of today's sensors and the limited number of analysts available to exploit the imagery. This situation will worsen by an order of magnitude as sensor systems are upgraded and new systems come on line. This effort will tailor and implement advanced ATR algorithms into analyst workstations using commercially available processing hardware consistent with current and evolving imagery exploitation standards. This effort will develop the capability to automatically recognize targets using high-range resolution radar and ISAR for moving targets. Advances in high-resolution imaging for stationary and moving targets, and advances in hybrid ATR algorithms using both template and model-based approaches, will be developed. This advanced imagery exploitation capability will be demonstrated using imagery from a number of reconnaissance/surveillance platforms to meet service-specific exploitation needs. Successful algorithm approaches will be applied across the services. The major technology barrier is algorithm robustness in the face of real-world target and background variability. This DTO will focus on tactically meaningful scenarios, finding and recognizing exposed targets in relatively benign backgrounds using template-matching techniques. Hybrid template-matching and model-based techniques will be demonstrated to expand the envelope of applicability of this technology to a larger target set and conditions, in a variety of tactically significant environments and backgrounds.

The program will, by FY97, demonstrate using JSTARS' proposed SAR upgrade 0.7 P_{id} and P_{fa} of 0.01 FA/km^2 against stationary critical mobile target; by FY98, demonstrate 0.9 P_{id} against stationary MRL and P_{fa} of 0.01 FA/km^2 using Predator SAR and demonstrate using JSTARS, detection, track maintenance, and 0.9 P_{cc} against high-value moving ground targets; and by FY99, demonstrate for U–2 and HAE UAV, detection, track maintenance, and 0.9 P_{cc} against high-value moving ground targets and demonstrate in P–3 and S–3 aircraft, using ISAR imagery, 0.85 P_{id} against moving ground vehicles and small ships.

Service/Agency POC	Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603238A	D546	8.5	6.1	4.0	0	0	0	0
0602232N		2.4	2.4	2.7	0	0	0	0
0602204F	7629	2.4	2.4	2.4	0	0	0	0
0602702E	TT-06	3.4	1.2	0	0	0	0	0
0603762E	SGT-04	20.3	33.2	27.5	8.7	0	0	0
0603760E	CCC-02	2.9	3.0	0	0	0	0	0
	Total	39.9	48.3	36.6	8.7	0	0	0

SE.23.02 ***Integrated Platform Avionics Demonstration.*** This DTO develops low-cost solutions for future tri-service retrofit and forward-fit applications in integrated avionics by utilizing tri-service development products in a series of testbed demonstrations. Areas of concern encompass system architecture, multifunction apertures, integrated RF and EO subsystems, core signal and data processing, vehicle management system, weapon stores management, power generation, and environment control systems. Tri-service transition vehicle opportunities would be JSF variants, NF–22, and current operational aircraft upgrades, both fixed wing and rotocraft. The objective is to lower entire life-cycle cost by attacking all aspects of the system acquisition process and many cost-inducing factors.

Two thrusts are currently underway supporting the DTO effort: the Maritime Avionics Subsystem Technology Program and the Aging Aircraft Avionics workshop held in September 1996 at WPAFB. The workshop, comprising corporate level representatives from the major aircraft prime contractors, depots, and Air Force commands, planned technology efforts to solve the upgrade and support issues for aging aircraft that will represent over 80% of the operational fleet for the next 35 years.

FY98 will develop individual enabling technology applications such as analog RF photonics, digital fiber optic networks, high-density electrical connectors, integrated sensor systems in the RF and EO domains, and digital IF processors. FY99–00 will produce "stairstep" demonstrations of system capability threads using incremental modeling and simulation integration demonstrations. The focus will include information fusion, portable operating systems, support software environments and COTS-based technology. These will be followed by incremental prototyping and integration demonstrations involving packaged hardware, reconfigurable or throw-away modules, and system software re-use. The final far-term demonstration will be real-time weapon system integration applications applied to a retrofit program for operational aircraft. Technology goals to be reached by FY00 include a 30% reduction in avionics suite cost (development, flyaway, and support) and reduced weight/volume/prime power by 30%. The tri-service testbed will allow timely integration of current enabling technologies and provide opportunities for tri-service access, common interface, and joint utilization of products.

Service/Agency POC	**USD (A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603217N	R0446	10.0	15.0	12.0	16.5	0	0	0
0602232N		1.5	0.8	0	0	0	0	0
0603253F	2735/3833	12.1	12.2	13.0	13.1	0	0	0
	Total	23.6	28.0	25.0	29.6	0	0	0

SE.24.02 ***Advanced Common Electronic Modules.*** The purpose of this effort, a new start in FY97 and funded under the Affordability Program, is to develop advanced common electronic modules consisting of two processing families: common sensor interfaces acquiring data directly from the sensors of the electronic suite in a platform; and digital processing computing nodes sustaining increased performance in processing, communication input-output bandwidth, and latency. The modules developed will be smaller and have lower power consumption and higher performance, while accomplishing all the acquisition, transmission, and digital processing of RF signal electronics over a very wide frequency range (50 MHz to 45 GHz). This technology incorporates all RF signal electronics (transmitting and receiving) into a small set of modules for signal conditioning and subsequent signal processing. Advanced Common Electronic Modules (ACEM) builds on over a $100 million DARPA investment including the High-Performance Computing, Rapid Application-Specific Signal Processing, and Electronics Packaging and Interconnect Technology programs.

This program will eliminate most analog electronics and perform the functions digitally. To accomplish this, the following must be achieved: improved high-speed A/Ds and D/As, RF up-and-down converters, high-speed digital signal processors, and low-power electronics. All of the RF functions will be processed by a single device. The success of this program will result in a 5:1 reduction in wiring, a 10:1 reduction in weight and power, and an 8:1 reduction in life-cycle cost (LCC) for electronic modules.

Tradeoff studies will be performed to define critical design parameters affecting requirements for system applications across the naval airborne, shipborne, undersea, and overhead platforms involving RF sensors, interfacing, and data processing assets. Once this is completed, a system design document describing recommended architecture(s) and function performance parameters will be developed, followed by advanced development models for an integrated processor. Demonstration tests initially will be performed in the laboratory and then in an SH–60R helicopter for flight testing.

Milestones include, in FY97, components validation, module design, and LCC modeling; in FY98, module design and prototyping and LCC module validation; in FY99, module assembly, fabrication and integration, and laboratory tests; and, in FY00, SH–60R installation and SH–60 flight demonstration.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602122N		2.0	2.5	0	0	0	0	0
0603217N	W0446	0	1.0	6.0	4.0	0	0	0
0603739E	MT-04	43.5	39.7	59.1	98.2	0	0	0
	Total	45.5	43.2	65.1	102.2	0	0	0

SE.26.01 ***Millimeter-Wave Power Modules.*** The objective of the MMPM effort is to develop a compact, lightweight, highly efficient transmit/receive module operating in the 18–40-GHz frequency range. The module technology is intended to support ongoing and planned communications and electronic warfare systems, as well as being compatible with application in multifunctions electronically steered, active arrays. The primary technical challenges encountered in this development are driven by the need to obtain efficient power production in a small package and to obtain a proper balance between performance and affordability. As with the microwave power module, the approach is to distribute the RF gain between the solid-state driver and the vacuum power booster to reduce the size, increase the efficiency, and reduce the noise performance of the module. The MMIC driver, vacuum amplification stage, and electronic power conditioning are optimized for functionality and efficiency. The need to respond to specific applications at an affordable cost determines the module configuration. Deliverables within this effort include delivery of two (Raytheon) and ten (Litton) MMPMs (transmit only) in FY97. Initial evaluation of the MMPM technology for electronic warfare is planned for FY98 with the implementation of a 1 x 8 active, electronically steerable array (NATO TRIAL MACE test) and an ALE–50-based MMPM towed decoy. Specific metrics for the MMPM effort are a wideband efficiency of greater than 30% and output powers greater than 45 W. This DTO supports JWCO Information Superiority (A.10, High-Altitude Endurance Unmanned Aerial Vehicle ACTD, and A.13, Satellite C^3I/Navigation Signals, Propagation Technology), Combat Identification, Electronic Combat, and Joint Theater Missile Defense.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		2.2	0.6	0	0	0	0	0
0602204F	2002	0.5	0	0	0	0	0	0
0603203F	69CK	0	0.2	0	0	0	0	0
Total		2.7	0.8	0	0	0	0	0

SE.27.01 ***Microwave SiC High-Power Amplifiers***. This DTO will develop compact, lightweight, highly efficient L- through X-band microwave solid-state transmitter building blocks for potential use in high-performance radar, communications, and electronic warfare systems. It will develop advanced silicon carbide (SiC)-based field effect transistors (FETs) and static induction transistors (SITs) that meet output power, power density, efficiency, linearity, operating voltage, and temperature to provide size, reliability, and life-cycle cost advantages over competing Si and GaAs-based solid-state amplifiers and tube-based RF transmitter systems. The program will further optimize SiC substrate and epitaxial material growth, device processing techniques such as ion-implantation, reactive ion etching, ultraviolet lithography, and contact metalization; and establish advanced device and amplifier design and simulation tools to reduce costs. A goal is to develop high-temperature and high-thermal conductivity interconnect and packaging technology to accommodate high-temperature applications and greater power dissipation levels. In FY97, the program will complete development of (1) 75-W S-band power SIT and 10-W X-band SiC MESFET, and (2) high-temperature interconnects as needed for SiC MMICs. The FY98 goal is development of 150-W S-band SIT and 25-W X-band MESFET. The program will demonstrate, by FY99, the applicability of a wide bandgap material, SiC, to prove high-power microwave amplifiers by demonstrating a 300-W S-band SIT and 100-W 10-GHz hybrid amplifier. This DTO directly supports the Air Force's AN/TPS–75 ground-based radar transmitter upgrade, impacts Army Patriot, GBR, and THAAD systems, as well as ground-based, shipborne, and airborne surveillance and fire control radars and EW jammer equipment. Other systems directly affected are the Navy SHF rapid deployment system, FAST SATCOM system, and Sea Sparrow transmitter. This DTO supports JWCO Information Superiority, Electronic Combat, and Joint Theater Missile Defense (D.04, Advanced X-Band Radar Demonstration).

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		0.9	0.3	0	0	0	0	0
0602204F	2002	0.5	0.9	0.8	0	0	0	0
0602712E	MPT-02	0	2.0	2.0	0	0	0	0
	Total	1.4	3.2	2.8	0	0	0	0

SE.28.01 ***Low-Power Radio Frequency Electronics.*** Man-portable communications and advanced airborne and space-based platforms are severely limited in volume and weight. In addition, the demands for wider bandwidth, higher stability, and increased functionality are challenging available technology. New lower power RF devices and components are needed to improve sensitivity and selectivity with reduced noise, while minimizing power consumption in planned and ongoing communications and sensor-based systems. This DTO encompasses design, fabrication, and simulation of device structures, circuits, and materials for power-efficient RF electronics, high-power added-efficiency amplifiers and sources, ultra stable frequency control oscillators and clocks, miniaturized low-loss filters and microresonators, circulators, and enhanced component thermal management technologies. In FY97, the program will develop low-power consumption GaAs RF ICs for advanced receivers with emphasis on use of heterojunction ICs for low-noise amplification over wider bandwidths. In FY98, the goals are to develop and demonstrate a low-noise, low-acceleration sensitivity frequency source with a fivefold improvement in acceleration sensitivity for improved slow-moving target detection capability (e.g., in JSTARS, by optimizing acoustic mode shape and device geometry); and to develop multifunction communications and radar ICs and subsystems for advanced receivers to achieve a fivefold reduction in power consumption, demonstrate miniature filters integrated into multifunction transmit/receive module assemblies, and conduct demonstrations of miniature digital receivers aimed at increasing performance at a reduced cost, size, and weight for radar/EW multifunction systems. By FY99, the program will demonstrate a low-power, high-accuracy clock that is five times smaller, two times lower power, and two times higher accuracy for jamming-/spoofing-resistant GPS receivers; and demonstrate small, man-transportable, extended autonomy-period MILSTAR terminals by exploiting new piezoelectric materials such as langasite and lithium tetraborate in addition to novel resonator structures. This DTO supports F–22 radar and EW, GBR, GEN-X, GPS, CEC, MILSTAR, Scamp, Longbow, BCIS, SADARM, STAFF, and BAT. The following JWCOs are supported: Information Superiority (A.13, Satellite C^3I/Navigation Signals Propagation Technology), Precision Force (B.03, Precision Signals Intelligence Targeting Systems ACTD, and B.05, Target Acquisition ATD), Combat Identification (C.01, Battlefield Combat Identification ATD), Electronic Combat, Joint Theater Missile Defense (D.04, Advanced X-Band Radar Demonstration), Military Operations in Urban Terrain (E.01, Small Unit Operations TD), and Joint Countermine.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602204F	2002	1.0	0.9	0.7	0	0	0	0
0603203F	69CK	0.6	0.6	0.5	0	0	0	0
0603762E	SGT-03	19.5	0	0	0	0	0	0
	Total	21.1	1.5	1.2	0	0	0	0

SE.29.01 ***Design Technology for Radio Frequency Front Ends.*** This DTO will develop tools and processes for the rapid and efficient design of monolithic microwave integrated circuits, multichip assemblies, and mixed signal electronic subsystems for use in high-performance electronic warfare, radar, and communication systems. The overall goals are to drive down system front-end costs, to increase system front-end capabilities, to enhance system portability, to upgrade reliability, and to reduce life-cycle costs. The MAFET Design Environment will help accomplish the above cost objectives by reducing RF multichip assembly module development from the present 20 man-years of effort to 6, and the cycle times from over 3 years to 1 by FY99. The number of design cycles will be reduced by providing more accurate models and developing a behavioral modeling capability to support earlier, system-level design space exploration (virtual prototyping). The time per design cycle will be reduced by developing faster simulation tools and better integration of design tools to allow more portability of designs and models among the tools. Front-end performance capability will be improved by providing the virtual prototyping to allow more realistic tradeoffs of system performance requirements with hardware capability. The approach is to provide enhancements and new developments by the leading computer-aided engineering (CAE) tool suppliers to address the above objectives, with tight coupling to the microwave/millimeter wave industry, and to establish processes to ensure end-user requirements are addressed. The mixed signal design system will enable the synthesis and simulation of digital signal processing hardware, software, and components in one application. The resulting capabilities will become part of the commercial product lines of these leading CAE system suppliers and will therefore be sustained after the government-sponsored program ends. In FY97, the program will release design environment interoperability specifications. In FY98, the program will release the beta version of design environment to all benchmark sites and demonstrate mixed signal coupling and contamination analysis software. In FY99, the final version of design environment for mixed-signal RF front-end designs will be evaluated. This DTO supports F–22 radar and EW, GBR, MILSTAR, Scamp, Longbow, BCIS, SADARM, STAFF, BAT, Aegis SPY–1D upgrade, ALQ–131, and ALQ–136. The following JWCOs needs are supported: Information Superiority, Precision Force, Combat Identification, Electronic Combat, Joint Theater Missile Defense, Military Operations in Urban Terrain, Joint Countermine, and Joint Readiness and Logistics.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602204F	6096	1.3	1.5	1.9	0	0	0	0
0603739E	MT-06	41.2	28.0	13.2	0	0	0	0
0602712E	MPT-02	0.3	0	0	0	0	0	0
	Total	42.8	29.5	15.1	0	0	0	0

SE.33.01 ***Advanced Focal Plane Array Technology***. This DTO includes both cooled and unincooled technology. The introduction of dual-band and multispectral sensing, coupled with smart processing, will give an automation capability to cooled infrared focal plane array (FPA) sensing that will permit the host weapons system to service targets quicker while reducing operator timelines and workload. Sophisticated growth and fabrication techniques will increase the functionality of the FPAs and make them more affordable. Uncooled FPA technology development is aimed at significantly increasing the sensitivity and resolution of the IR sensor while maintaining low cost, weight, and power consumption. In addition, the integration of IR and low-light-level FPA (technology development under solid-state IR camera in the Display thrust) imaging in one lightweight, compact sensor system will substantially improve night operation of individual soldiers, increase rifle sight effectiveness, and allow the development of low-cost missile seekers. This DTO relates to a number of JWSTP DTOs including A.06, Rapid Battlefield Visualization ACTD; C.01, Battlefield Combat Identification ATD; D.02, Integrated Sensor/Data Fusion Demonstration; D.05, Advanced Space Surveillance; and G.02, Land-Mine Detection. In addition, IR FPAs are extensively referenced as key technologies in the following JWCO goals: Combat Identification, Joint Theater Missile Defense, Joint Countermine, and Electronic Combat.

Specific objectives include complete flexible manufacturing technology for mercury cadmium telluride (MCT) for burst-mode operation (FY97); demonstrating thin-film ferroelectric FPA with noise-equivalent delta temperature (NEDT) of 0.05 K (FY97); determining material, isolation structure and pixel design for high-resistivity uncooled FPA, and design a dual-spectral uncooled sensor imaging in the visible/near IR and 8–12-micron spectral regions. Visible/near IR technology will be leveraged from the near IR solid-state IR camera effort under the Display thrust (FY98); demonstrating NEDT of 0.01K for uncooled FPA with 30-micron pixels (FY99); demonstrating a ten times reduction in false alarm rate with dual-band FPA sensing resulting in a two times increase in effective detection range (FY99); and demonstrating dual-band and dual-color sensing and partition smart functions between on- and off-focal plane processing (FY99).

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602705A	AH94	0.9	0.9	1.0	0	0	0	0
0602709A	AH95	5.6	5.0	5.5	0	0	0	0
0602232N		0.8	0.8	0.8	0	0	0	0
0603739E	MT-03	23.1	9.0	11.0	0	0	0	0
	Total	30.4	15.7	18.3	0	0	0	0

SE.35.01.FE ***Optical Processing and Memory.*** High-speed signal processing and information storage for C^4I is driven by such operational realities as increasing jammer densities against C^4 assets, low-observable target surveillance, and handling large intelligence databases. Additionally, the performance limits of conventional electronic approaches to air and ground surveillance are stressed by low-observable threats, sophisticated electronic countermeasures, increased tactical target densities, and complexity of the modern battlefield, all mandating high processing speeds. A number of multispectral sensor fusion techniques and electronic counter-countermeasures have been widely identified as a means to increase surveillance capabilities against these threats. The processing requirements of many of these schemes, however, remain prohibitive, outpacing the rate of advance of conventional all-electronic components. Hybrid or all-optical techniques offer a potential solution to this processing dilemma. Goals are to achieve tera operations/second in a massively parallel optoelectronic processor small in size and low power.

In the memory area, the objective is to provide the necessary storage and retrieval device technologies for the timely dissemination of highly volatile C^4I information achieving terabit-petabit (10^{12}–10^{15}) storage with nanosecond access times in 1 cm^3 volume. Revolutionary concepts in information storage and retrieval to provide (1) higher capacity, faster throughput, and decreased access time for data handling and (2) timely intelligence to the warfighter will be developed. The advent of optoelectronic computers and highly parallel electronic processors has brought about a need for storage systems with enormous memory capacity and bandwidth. These demands cannot be met with current memory technologies (e.g., semiconductor, magnetics) without having the memory system completely dominate the processors in terms of overall cost, power consumption, and volume.

Specific goals of this DTO include demonstration of a 3D write-once–read-many (WORM) times optical memory system (FY98); demonstration of parallel optical interconnects up to 2.5 Gb/s (FY99); demonstration of free space optical interconnects up to 1 Gb/s (FY00); demonstration of 2D photonic modules with greater than 1,000 smart pixels per cm^2 (FY00); demonstration of 1 trillion operations/second optoelectronic processor (FY00); and demonstration of a read-write-erase 3D memory (FY00).

This DTO is related to JWSTP DTO A.09, Semiautomated Imagery Processing ACTD, which references the need for a mass storage capability to provide memory for change detection. Mass data storage is also referenced as a key technology under JWCO, Information Superiority.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602702F	4600P	3.0	3.0	3.0	3.0	0	0	0
0603726F	2863	1.4	3.4	3.6	3.9	0	0	0
0603739E	MT-04	9.1	10.0	10.0	0	0	0	0
0602712E	MPT-02	15.7						
	Total	29.2	16.4	16.6	6.9	0	0	0

SE.36.01 ***Photonics for Control and Processing of Radio Frequency Signals.*** The wide bandwidth of optical waveguides provides new options for RF communications and surveillance. The terahertz bandwidths available through photonic waveguide technology provide significant gains in performance in existing RF systems, as well as options for much greater bandwidths for RF requirements in radio and radar applications in future applications. In addition to the wide RF bandwidths that are available on photonic-based waveguides, they are flat in frequency and phase response over very large RF bandwidths (hundreds of gigahertz), and have very low transmission losses—much lower than metallic waveguides. Benefits of photonically based RF signal distribution, true time-delay beam steering, and RF antenna remoting implemented into electronic systems include immunity to interference, lighter weight, and improved flexibility in electronic systems design. True time-delay beam formation and beam steering implemented into RF phased arrays will result in very wide bandwidth multifunctional antennas with conformal construction and the ability to do both multiple target tracking and identification within a single array. Because size scales with wavelength, it is possible to develop RF systems at a fraction of the conventional size because the RF energy is carried at the lightwave frequency (micron wavelength). Compact, wide frequency range systems are possible (e.g., synthesizers, up/down converters, filters, channelizers).

This program will achieve performance improvements due to better bandwidth capability (1,000 times) as well as cost savings due to lighter, smaller (100 times), and less complex and demanding assemblies. It will develop components to demonstrate RF system impact by introducing photonics technology in phased array antenna systems, channelizers and down converters, microwave RF interconnects, and beam formers.

This DTO is a high-speed analog fiber optic technology with relevance to JWSTP DTO B.12, Enhanced Fiber Optic Guided Missile (EFOGM) ATD. Related high-speed (optical and fiber optic) datalinks are key technologies referenced under goals for JWCOs Joint Theater Missile Defense, Military Operations in Urban Terrain, and Joint Readiness and Logistics. It will demonstrate a 2–18-GHz optical interconnect system for airborne RF signal distribution (FY98); millimeter-wave modulators and detectors for EHF SATCOM, and EW ECM (FY99); 1–100-GHz optical RF frequency synthesizer for EW, ELINT, and ECM (FY99); 1–100-GHz channelizer for ELINT/SIGINT (FY00); and a full-scale phased array controlled photonically for SATCOM and ECM (FY00).

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602705A	AH16	1.9	2.0	2.2	0	0	0	0
0603006A	257	0.5	1.4	2.4	1.5	0	0	0
0602234N		1.7	3.4	3.1	0.4	0	0	0
0602702F	4600P	2.0	3.0	3.0	2.0	0	0	0
0603726F	2863	0.7	1.7	1.7	1.9	0	0	0
	Total	6.8	11.5	12.4	5.8	0	0	0

SE.37.01 ***High-Density Radiation-Resistant Microelectronics***. High-performance, extremely dense, radiation-resistant microelectronics are key to continued U.S. domination of battlefield surveillance, intelligence, and communications, as well as joint theater missile defense. This DTO focuses on providing space and strategic systems with timely access to affordable state-of-the-art, radiation-resistant microelectronics. Space applications, which presently dominate requirements for radiation-resistant microelectronics, need to operate reliably after exposure to natural and nuclear radiation (e.g., total dose greater than 300 krad, dose rate upset thresholds greater than 10^8 rad/sec, SEU thresholds greater than 40 MeV/cm^2/mg). These systems also demand significant reductions in weight, size, and power while simultaneously increasing performance. Customers for radiation-resistant microelectronics include strategic missiles (Minuteman and Trident), BMDO interceptor systems, and satellites such as MM-III GRP, EKV, MILSTAR, UHF follow-on, GPS-IIF, DSP, SBIRS-High, SBIRS-Low (SMTS), and Advanced EHF.

Specific technology objectives include demonstration of power converters with 95% efficiency by FY97; demonstration of a radiation-hard, single-chip, 16-bit silicon-on-insulator (SOI) processor for strategic missile applications by FY97; development of a submicron radiation-resistant microelectronics fabrication process to produce a 16 times increase in density, and enable development of a 32-bit data processor by FY98 and a radiation-resistant 4-Mb static memory by FY99; demonstration of a 256 k-bit nonvolatile memory by FY99; and development of an extremely high-density, mixed-signal sensor processor that incorporates next-generation packaging concepts by FY99.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603401F	2181	5.0	5.0	1.0	0	0	0	0
0602715H	AF	3.5	2.0	2.5	0	0	0	0
	Total	8.5	7.0	3.5	0	0	0	0

SE.38.01 ***Microelectromechanical Systems.*** MEMS components are expected to improve the size, weight, cost, and assembly complexity of existing applications areas such as positioning systems and inertial guidance systems by an order of magnitude. MEMS promises to allow new programs started in the near term to deploy accelerometer, GPS, and inertial guidance functions an order of magnitude lower in size, weight, cost and assembly complexity than alternative technologies. Key near-term challenges are to develop the basic materials, devices, and processes to integrate mechanical components at a density of 1,000 mechanical components/cm^2 with on-chip microelectronics of at least 10,000 transistors. A basic support for this technology area will be the development of an infrastructure that not only can build single prototype components at increasing densities and complexities, but also lays the foundation for establishing a reliable, assured industrial base to supply emerging defense applications.

Specific technology objectives include development of an integrated inertial guidance system on a chip in FY97; demonstration of a high-performance accelerometer that is monolithically integrated with electronics exhibiting ten times improvement in stability and sensitivity over current accelerometers in FY98; and demonstration of integration densities of 500 integrated mechanical components/cm^2 in FY98, and densities of 1,000 integrated mechanical components/cm^2 in FY99.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602204F	6096	0.2	0.7	0	0	0	0	0
0603739E	MT-12	43.8	54.1	55.5	0	0	0	0
0602712E	MPT-01	1.7	6.0	8.0	0	0	0	0
	Total	45.7	60.8	63.5	0	0	0	0

SE.39.01 ***Wide-Bandgap Electronic Materials Technology.*** This DTO develops high-performance, wide-bandgap semiconductor materials for advanced compact transmitters used in military-essential RF radar, communications and electronic warfare sensors, and compact laser sources and detectors. The availability of silicon carbide wafers compatible with commercial semiconductor processing technology is essential to ensure an adequate yield of devices to meet systems performance/cost requirements. Attainment of the silicon carbide goals will enable production of high-power switches operating at greater than 1,000 V and at current densities exceeding 1,000 amps/cm^2. The resultant power density exceeds that of silicon by a factor of five, achieving considerable size and weight reduction of power supplies in support of all electric ships and More Electric Aircraft. Development of SiC, GaN, and AlN will enable implementation of 50-W, 18–40-GHz power modules for compact EW transmitters; blue light-emitting diodes with greater than 10,000 hours lifetime; blue and ultraviolet lasers with greater than 1,000 hours lifetime; and solar-blind ultraviolet detectors. In FY97, the program will complete development of 150-W SiC SIT, 25-W X-band MESFET, and high-temperature interconnects for SiC MMICs, as well as develop controlled p-doping of GaN epitaxial films. The FY98 goal is to demonstrate 3-in diameter substrate wafers of 4H and 6H silicon carbide with uniform doping and defect density less than 10^3/cm^2 across the entire wafer, high-resistivity silicon carbide substrates, 150-W S-band SIT, and a 25-W X-band hybrid amplifier. Other FY98 goals include developing reproducible epitaxial growth of doped and semi-insulating, low-defect density (less than 10^5/cm^2) GaN; and demonstrating reliable shallow p-type doping technology for epitaxial growth of GaN. In FY99, the program will develop a commercially viable epitaxy process that yields materials properties (defect density, control of dopants) that exceed substrate quality, demonstrate a 300-W S-band SIT and 100-W 10-GHz hybrid amplifier, develop a means to synthesize GaN substrates of 1 in or greater diameter, and develop effective doping of high aluminum alloy ratio AlGaN material.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		1.7	0.8	0.3	0	0	0	0
0602204F	2002	0.6	0.3	0.3	0	0	0	0
0602102F	2423	0.7	0.9	0.9	0	0	0	0
0602203F	3145	0.4	0	0	0	0	0	0
0602702F	4600	0	0.2	0.2	0	0	0	0
0602712E	MPT-01	3.1	0	0	0	0	0	0
0602712E	MPT-02	3.3	5.0	4.0	0	0	0	0
0602173C	1651P	1.2	1.2	1.2	0	0	0	0
0602173C	1651Q	0.4	0.4	0.4	0	0	0	0
0602173C	1660.1	0.9	0.5	0	0	0	0	0
	Total	12.3	9.3	7.3	0	0	0	0

SE.43.01 ***Energy Conversion/Power Generation***. This DTO will demonstrate small, lightweight, low-cost, environmentally compatible power sources with high power and energy densities by providing, in FY98, at least a 50–100% increase in energy density for electrochemical, electromechanical, and other direct energy conversion devices. This advance in energy density will enable corresponding reductions in portable power source size and weight (30–50%), and support increase power demands for man-portable electronics, sensors, lightweight TOCs, etc. This will contribute to the military's ability to project mobile forces, execute longer missions, and provide power on the move. All efforts will improve the deployability, tactical mobility, and effectiveness of a CONUS-based fighting force.

The program will deliver next-generation primary batteries (30% increase in power density) for tactically mobile use in the 21st Century Land Warrior Field demonstration in FY98; deliver initial prototype fuel cells for field demonstrators to Dismounted Battlespace BattleLab (ACTII demonstration) and Special Forces Command (60% reduction in power source weight) in FY98; deliver next-generation 60-lb, diesel-fuel-burning, 3,000-W engine driven generator set for use in the Gen II and Hunter Sensor Suite ATDs in FY98; and demonstrate liquid-fueled fuel cell in FY99.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602705A	AH11	1.8	2.0	1.9	0	0	0	0
0602234N		3.0	3.5	5.0	0	0	0	0
Total		4.8	5.5	6.9	0	0	0	0

SE.44.01 ***Power Control and Distribution***. Advanced military platforms are becoming near all-electric to meet mission performance and requirements. To meet these challenging objectives in generating, converting, and distributing electric power requires the minimization of the cost, weight, and volume/size of power electronics while maximizing performance—the product of current density, standoff/blocking voltage, and turnoff time or switching frequency. These advanced systems anticipate tenfold improvements in power density and a factor of 3–5 in the reliability and switching speed for power electronic building blocks (PEBBs) over the present-generation conversion and distribution systems technology. The power, control, and distribution (PCD) envelope must encompass commonality, performance (e.g., power density, affordability, maintainability), and dual-use applicability. Meeting the PCD goals for FY00 and FY05 will require advancements in power switching devices and diodes, gate drivers and power control electronics, power circuit and topology, packaging, and thermal management technologies. Significant military capabilities in consort with industry commercial market, will provide for flexibility and commonality through the development of the smallest number of PEBB components for the largest number of applications. This DTO develops technologies to revolutionize, through the use of PEBBs, the way electric power is produced, stored, distributed, and used using the U.S. industrial infrastructure for volume manufacturing, and it achieves reduced cost for military and private sector applications.

The program demonstrates a 100-W, 50–3.3-Vdc, high-efficiency, high-density, low-voltage power that operates at 1 MHz with a conversion efficiency of 90% in FY97. Further advances in the use of wide bandgap materials for power applications will realize additional improvements in conversion efficiency while increasing switching speeds to as high as 100 MHz by FY00. The program also will demonstrate PEBBs for application in advanced shipboard for a "More Electric Navy" (e.g., SC–21, airborne, combat systems, vehicular platforms), providing ten times improvements in power conversion, distribution efficiency, power density, and switching speeds that reduces the size, weight, and cost; and a three to five times improvement in reliability by FY00. A goal is to provide 90% reduction in cost for power, using digital-controlled elements.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602234N		1.2	3.2	0.2	0.2	0	0	0
0602204F	6096	0.6	1.1	1.1	0.9	0	0	0
0603203F	69CK	0.7	0.6	0	0	0	0	0
0603430F		0.5	0	0	0	0	0	0
0602712E	MPT-01	4.1	6.9	8.0	8.0	0	0	0
0602712E	MPT-06	1.7	4.0	8.0	9.0	0	0	0
	Total S&T	8.8	15.8	17.3	18.1	0	0	0
0603805E*	GC-01	0.6	0.6	0	0	0	0	0
	Total	9.4	16.4	17.3	18.1	0	0	0

*Non-S&T funds.

SE.45.01 ***Forecast of Littoral Currents and Waves***. This DTO develops and delivers for operational testing an improved forecast capability for small-scale currents and waves in littoral areas. The accurate characterization and forecast of surf, coastal ocean currents, and waves are important to contingency planning, operational planning, and execution of a number of naval operations in the littoral environment. This DTO provides capabilities required by the JWSTP for Joint Readiness and Logistics and Information Superiority (A.19, Extending the Littoral Battlespace ACTD). Operational research analyses have shown that the ability to accurately forecast current and wave fields leads to optimal use of forces in amphibious/raid operations. Exploitation of accurate forecasts during a naval raid to improve ingress and egress locations and timing can lead to an increase of 15% combat power put ashore, an increase of 75% in the time period for full force operations, and a 20% reduction in high vulnerability/risk time in extracting the force ashore.

This program will develop and demonstrate shipboard, workstation-hosted, four-dimensional ocean current and waves forecast capabilities for the littoral environment. Parameters will include temperature, salinity, currents, tidal elevation, and shallow-water wave and surf heights, periods, and directions. The existing Navy Ocean Model, Assimilation, Demonstration System (NOMADS) is a research and development "breadboard" to develop and demonstrate shipboard, workstation-hosted ocean nowcast and forecast systems. NOMADS will be specifically used to facilitate these transitions to operational environmental systems afloat and at the NAVOCEANO Warfighting Support Center.

Out-year capabilities of the NOMADS framework will include the nowcast/forecast capability for coastal temperature, salinity, and currents. The initial capability including temperature, salinity, and wind-forced currents will transition in FY97. Inclusion of models with tidal and density-driven currents will allow a true near-shore capability for FY98 transition. An upgrade to the existing operational Navy standard surf model will also occur in FY98, including wave transformation caused by refraction and diffraction in shallow water coupled to the an upgraded surf forecast module. Effects of coupled waves and tides will be added as an upgrade transitioned in FY99. The additional inclusion of high-resolution coastal current capabilities will transition in FY00.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602435N		1.7	1.7	1.2	1.2	0	0	0
	Total S&T	1.7	1.7	1.2	1.2	0	0	0
ACW*		0.5	0.5	0.5	0.5	0	0	0
	Total	2.2	2.2	1.7	1.7	0	0	0

*Army Civil Works R&D Program 321; non-S&T funds.

SE.47.01 ***Autonomous Ocean Sampling Network: Mapping of Ocean Fields***. This program will demonstrate the utility of autonomous unmanned underwater vehicle (UUV)-based environmental characterization. The DTO demonstrates through field trials the capability of acquiring, in a littoral zone, real-time ocean and bathymetric data necessary for mine warfare (MIW), amphibious warfare, and antisubmarine warfare (ASW) operations. This DTO addresses JWSTP areas of Joint Countermine (G.09, Advanced Underwater Sensors) and Information Superiority. The importance, indeed the revolutionary nature, of the concept of autonomous ocean sampling networks for naval warfare in the future has been endorsed by the Secretary of the Navy and the Chief of Naval Operations. Of great significance is the ability of UUVs to conduct ocean sampling in a covert manner, especially in those littoral operations where military interest must remain concealed but where environmental data are necessary prior to the operation. The need for a real-time covert or overt means of acquiring ocean environmental data is as a high priority of the Naval Oceanographic Office (NAVOCEANO).

The autonomous ocean sampling network will be capable of numerous types of missions in the littoral zone depending on the sensor suites available. The system will be capable of programmed mapping of critical 3D ocean fields (and ultimately of real-time adaptive sampling in 4D). For the timeframe of the DTO, the focus will be the accurate mapping of ocean fields—bottom bathymetry accurate to l-m horizontal and 1/2-m vertical resolution—and measurement of sound speed to 1 m/sec. This technology is immediately transferable to naval bathymetry survey operations with remotely operated vehicles (ROVs). ROVs reduce the cost of acquiring bathymetric data while they increase the area of data coverage. Orca, NAVOCEANO's ROV, is used to gather bathymetric data. In cost effectiveness, Orca costs about $1.6 million, versus a T–AGS (survey ship) cost of about $65 million (i.e., Orca is l/40 the cost of a ship). Alternatively, survey coverage is 1.8 to 2 times more by using Orca plus ship than by use of ship alone.

In FY97, the program will pursue development of environmental sensors as well as related technologies that may be utilized on autonomous UUVs, and evaluate the environmental sensors under development by the Army for applicability. In FY98, the goal is to conduct joint operations off' North Carolina with NAVOCEANO, its ROV, and autonomous vehicles. By FY00, the program will demonstrate an integrated autonomous ocean sampling network of oceanographic measurement nodes for high-resolution spatial and temporal characterization of complex ocean features. Short-term technical barriers include multiple-vehicle underwater communications; subsurface navigation; and small, lightweight sensors for the variety of ocean properties.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602435N		2.4	0.5	0.6	0.7	0	0	0
	Total S&T	2.4	0.5	0.6	0.7	0	0	0
ACW*		0.3	0.3	0.3	0.3	0	0	0
	Total	2.7	0.8	0.9	1.0	0	0	0

*Army Civil Works R&D Program 321, non-S&T funds.

SE.52.01 ***Weather/Atmospheric Impacts on Sensor Systems.*** The objective of this program is to develop and validate the models which translate the measured or forecasted state of the atmosphere into terms that define the impact of the atmosphere on specific combat systems and operations. All battlespace activities require sensors that operate in or through the lower atmosphere (communications systems, weapon systems, reconnaissance systems, etc.). A common requirement for all these systems is a knowledge of the propagation characteristics at the required wavelengths (from the visible to the microwave regions). This objective will be met through joint service developments of atmospheric propagation models and comprehensive electro-optical tactical decision aids (EOTDAs) that incorporate the propagation models into a complete description of targets, backgrounds, and system characteristics.

Milestones include: in FY98, development of an infrared thermal model for advanced EOTDA model with a 25% improvement in lock-on range estimation, and demonstration of a 40–60% increase in weather data input to mission planning from an integrated propagation code for Army Division Task Force XXI; in FY99, installation of a more advanced coastal region aerosol model that incorporates, for the first time, surf and anthropogenic aerosol sources; and, in FY01, transition of the tactical targeting EO simulator to AF Mission Planning System, introducing the capability to specify detailed scenes based on spectral response of the weapon system.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602784A	AH71	0	1.1	1.1	1.2	1.2	0	0
0603707F	2688	1.4	1.6	1.6	1.6	1.4	1.3	0
0602435N		0.8	0.7	0.5	0.5	0.5	0	0
	Total	2.2	3.4	3.2	3.3	3.1	1.3	0

SE.53.01 ***On-Scene Weather Sensing and Prediction Capability***. Effective joint combat operations demand detailed weather intelligence in order to plan for and execute the mission. The overall goal of this objective is to develop local, regional, and global prediction systems that describe and forecast battlespace environment parameters to support the increased use of sophisticated environment-sensitive battlespace surveillance, communications, and weaponry assets for mission planning; ship, aircraft, and ground vehicles movement; logistics; and strategic and tactical operations that degrade gracefully as communications and observational systems degrade. The goal is a weather-sensing, analysis, and forecast capability based on robust regional and battlespace models to satisfy joint service needs. This leads to a broad area 10% forecast improvement in militarily significant weather; with improvement of up to 40% for selected small-scale forecasts for specific targets. As such, it can support Precision Force through improved joint force decisions concerning the best times to neutralize enemy targets under specific weather conditions. The evolving nature of conflict—putting greater reliance on reactive forces deployed to small-scale battlespace events worldwide—requires that this sensing and prediction capability satisfy the joint needs of the services for in-theater battlespace (mesoscale) weather support to combat operations. Products from this objective will be transitioned through a joint tactical weather system.

Milestones include, in FY97, delivering cloud and aviation impact variable algorithms for USAF Theater Battle Management transition; in FY97, demonstrating the feasibility of tactical weather radar to measure radial wind, Doppler spectrum width, and precipitation type which will provide more than an order of magnitude improvement in analysis resolution of wind and moisture fields; in FY98, demonstrating a ground-based mobile atmospheric profiler that can reduce the observation/analysis turnaround time by 4-8 hours thereby reducing vehicle and personnel demands by one-third; in FY99, demonstrating a nested air–sea-coupled regional prediction system for operational implementation capable of improving forecast resolution by a factor of five, allowing prediction of tactical parameters such as visibility and EM refractivity, and delivering to IMETS an upgraded battlefield forecast model that reduces the error of cloud amount and precipitation amount forecasts by 40%; and, in FY01, incorporating prediction of aerosol-size distributions into regional and global prediction systems to provide, for the first time, detailed visibility and explicit cloud forecasts.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602784A	AH71	0.9	0.9	1.0	0	0	0	0
0602601F	1010	0.9	0.9	1.0	0.8	0.5	0	0
0603707F	2688	0.6	0.4	0	0	0	0	0
0602435N		0.3	0.7	0.7	0.6	0.6	0	0
Total		2.7	2.9	2.7	1.4	1.1	0	0

SE.55.01 ***Space Radiation Mitigation for Satellite Operations***. The increased dependency of the DoD on space-based assets makes it imperative that these space systems provide uninterrupted support to military operations. Satellite operations are adversely affected by space radiation, which can cause transients in, or failure of, sensitive electronic components and premature degradation of space power systems and other satellite systems. The objectives of this DTO are (1) to establish the causal relationship between the space radiation environment, satellite anomalies, and satellite systems degradation and failures, and (2) to develop techniques and instrumentation to mitigate these adverse effects of the space radiation or to provide alerts of the occurrence of hazardous space environments. The technology challenges addressed by this DTO are (1) to validate the effectiveness of the charge control system (CCS) technology to autonomously detect and eliminate the occurrence of high-voltage charging on operational satellites and thus eliminate the hazard such charging poses, (2) to demonstrate in space highly miniaturized operational sensors systems for real-time alerts of space environmental hazards, and (3) to develop and fly a compact system to determine routinely the space environmental hazards to new and emerging space technologies. The specific demonstrations supported by this DTO are the Compact Environmental Anomaly Sensor (CEASE) to provide real-time alert, the Bulk Charging Hazards Interaction System (BCHIS) to determine charging hazards to new technologies, and the Photovoltaics Arrays for Space Power (PASP) testbed to determine the effects of the space environment on the performances and lifetimes of new and emerging space power technologies applicable to space-based radars (SBRs) and other high-power systems. The near-term vision is to have CEASE included as an in situ diagnostic for all future military space systems.

Milestones include: in FY98, complete assessment of CCS mitigation techniques, with the elimination of all spacecraft charging hazards on operational satellites using CCS techniques; in FY99, demonstrate CEASE functionally in spaceflight, with a goal of 90% local specification of hazardous space conditions for operational satellites flying CEASE; and, in FY01, space flight BCHIS test system, showing a 25% increase in speed of application of BCHIS tested technologies to space system design.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	1010	0.3	0.6	0.5	0.6	0.6	0	0
0603410F	2822	1.7	3.2	3.5	3.8	3.9	0	0
0603410F	2823	0	0	0	0	0	0	0
	Total	2.0	3.8	4.0	4.4	4.5	0	0

SE.56.01 ***Satellite Infrared Surveillance Systems Backgrounds***. Military space surveillance systems rely on accurate background scene radiance for IR filter designs in order to enhance military intelligence surveillance and reconnaissance and missile warning capabilities. The objective of the DTO is to develop modeling and simulation (M&S) tools, derived from midcourse experiment (MSX) and Miniature Seeker Technology Integration (MSTI) satellite data, to enable optimized filter specifications and demonstration of satellite constellation effectiveness in wargaming scenarios. The technical challenges are to fuse the vast quantity of IR imagery data from MSX and MSTI and to extract from these data the capability to predict accurate background signatures. Near-term goals are to develop a new algorithm to predict the spatial structure in atmospheric, cloud, and terrain radiance backgrounds to greatly reduce the uncertainties in background clutter levels which currently limit IR sensor designs when detecting targets of interest. In general, M&S tools under development are geared toward meeting the timelines of the Space-Based Infrared System (SBIRS)-High, and future IR systems such as the SBIRS-Low and the Ground-Based Interceptor.

Milestones in FY97 include delivering atmospheric spatial structure background code with a 25% improvement in clutter suppression algorithms; in FY98, integrating atmosphere, cloud, and terrain backgrounds with a 25% improvement in sensor accuracy; in FY00, delivering to BMDO 3D background clutter simulation code with a 50% improvement in clutter suppression algorithms; and, in FY01, delivering to BMDO real-time scene generation codes for M&S with a 50% improvement in target-image reconstruction.

POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	1010	2.1	2.1	2.1	2.1	2.1	0	0
	Total S&T	2.1	2.1	2.1	2.1	2.1	0	0
0603871C*	1155	3.9	3.9	3.8	3.5	0.4	0	0
0603872C*	1155	1.1	1.1	1.1	1.1	1.1	0	0
	Total	7.1	7.1	7.0	6.7	3.6	0	0

*Non-S&T funds.

SE.57.01 ***Analog-to-Digital Converter.*** Significant advances have been and continue to be made in both silicon and III-V semiconductor IC technologies. DoD systems can reap the benefits of these emerging technologies in both retrofit and new programs. Emerging advances in IC technologies will allow the digital interface to migrate closer to the sensor/antenna in military receivers, reducing or completely eliminating the analog down-conversion stages that are bulky, costly, temperature sensitive, and require considerable calibration. This DTO focuses on the analog-to-digital converter (ADC), which is the key component for managing all sensor data in a wide range of areas (e.g., space-based electronics, ASW, smart weapons, C^4I). The capabilities of many defense systems are currently limited by the performance of their ADC, with particular known and projected threats in operational scenarios and jamming environments. Frequently, system requirements involve the fusion of several information processing and control functions that must be performed with real-time responses at very high rates (10–10,000 GFLOPs) while striving to increase the reliability/manufacturability of the system and simplify both the receiver and the transmitter. The primary objective of this DTO is to develop ADCs and related components to demonstrate digital receivers targeting military radar, EW, and CNI systems with the initial demonstrations in digital receivers and EW radar (E2C and AWACS). Some specific impacts of these developments and demonstrations are a 16 times improvement over current 1996 capabilities in over-the-horizon detection, detection of a submarine periscope in clutter, and precision tracking of horizon sea-skimming cruise missiles in clutter. Programs that are expected to employ these technologies include the F–22, Comanche, JSF, Aegis SPY 1–D, F–15 APG–63 upgrade, F–18 APG–73 upgrade, E2C APS–145 surveillance radar, and B–2 APQ–181 radar. Specific development objectives include an 8-bit, 3-Gsps and a 12-bit, 100-Msps GaAs HBT ADC by FY97; a very accurate 16-bit, 125-Msps ADC in CMOS/SOS by FY97; a 10-bit, 1-Gsps GaAs HBT ADC by FY98; and a 4-bit, 20-Gsps ADC implemented in CMOS/SOS by FY99.

The goal is application of these advances for down conversion with an InP HBT bandpass Δ-Σ modulator for a double down-conversion receiver (180-MHz center frequency) by FY97, with improvements for a single down-conversion receiver (1-GHz center frequency) by FY98, and a direct conversion receiver (10-GHz center frequency) by FY99.

Service/Agency POC	USD(A&T) POC	Customer POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602204F	6096	0.6	0.7	0.1	0	0	0	0
0603203F	69CK	0.9	1.0	1.1	0	0	0	0
0602234N		0.6	0.9	0.9	0	0	0	0
	Total	2.1	2.6	2.1	0	0	0	0

SPACE PLATFORMS

SPACE PLATFORMS

SP.01.06 ***Cryogenic Technologies.*** This DTO will demonstrate advanced cryogenic cooling technologies for SWIR, MWIR, LWIR, and VLWIR space surveillance sensors requiring operating temperatures between 10 K and 150 K; and will develop Stirling, Brayton, and pulse tube cryocoolers that reduce launch weight, improve power efficiency, lessen vibrations, and lengthen on-orbit lifetimes while providing sufficient cooling to maintain focal planes at required temperatures.

Demonstrated technology goals for cryogenics include reducing specific mass from the current level of 15 $kg/W_{cooling}$ to 8 $kg/W_{cooling}$ by FY00 and 5 $kg/W_{cooling}$ by FY05; reducing specific power (watts of input power per watt of cooling) from the current level of 70 $W/W_{cooling}$ to 50 $W/W_{cooling}$ by FY00 and 40 $W/W_{cooling}$ by FY05; increasing life expectancy from the current 2-year level to 5 years in FY00 and to 7.5 years by FY05; and reducing induced vibrations from the current level of 1.0 Nrms to 0.1 Nrms by FY00 and 0.01 Nrms by FY05. Technology payoffs are increased payload mass fraction, extended on-orbit life, and improved sensor resolution due to a reduced vibration environment.

These technologies will be demonstrated through the development of protoflight engineering models and laboratory testing. Milestones include delivery of an Advanced 35 K/60 K Cryocooler in FY99 and demonstration of the No Moving Parts Advanced Cryocooler in FY01.

Technology barriers/challenges include: availability of lightweight components for use in cryogenic temperatures; excessive friction and material stresses in miniature-sized, high-frequency cycles; contamination of seals and orifices; lack of effective design and materials for cryogenic regenerators; poorly understood thermodynamic loss mechanisms; and ineffective vibration isolation control electronics and techniques.

Customers for cryogenic technologies include those who use sensors for space surveillance and missile warning and tracking missions, specifically the SBIRS program, NASA, and NPOESS environmental sensors. This technology also supports development of low-temperature superconducting electronics pervasive to all DoD space vehicles, as well as USSPACECOM, NASA, and other space programs.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603401F	682J	0.6	0.6	1.1	1.6	1.9	7.6	7.8
	Total	0.6	0.6	1.1	1.6	1.9	7.6	7.8

SP.02.07 ***Thermal Management Technology.*** This DTO develops and demonstrates thermal management technologies to improve the performance and reliability while reducing the mass of space vehicle thermal management subsystems; and develops variable-conductance and loop heat pipes, capillary pumped loops, and composite material radiators to improve the capability of the thermal subsystem to eliminate excess heat from the space vehicle and provide the required thermal environment for optimal mission completion.

Demonstrated technology goals for space thermal management include increasing heat flux from the current level of 2.9 W/cm^2 to 3.8 W/cm^2 by FY00, and to 5.2 W/cm^2 in FY05; increasing heat transport from the current level of 2.5 kW-m to 4.5 kW-m by FY00, and to 9.0 kW-m by FY05; decreasing thermal subsystem mass from the current 0.04 kg/W to 0.038 kg/W by FY00, and to 0.034 kg/W by FY05; decreasing electronic component temperatures from the current level of 125°C to 120°C by FY00, and to 115°C by FY05; and decreasing space vehicle heater power from the current level of 0.11 W/W to 0.088 W/W by FY00, and further to 0.072 W/W by FY05. Technology payoffs are increased payload fraction and extended on-orbit lifetimes.

The program includes extensive ground testing. For two-phase fluid systems, final demonstration is accomplished on dedicated space missions, due to the inability to simulate the zero-g environment on Earth and possible significant effects on performance due to the gravity field. Milestones include delivery of one micron CPL wicks for characterization in FY99, delivery of a carbon-carbon radiator for flight test on New Millennium in FY97, and delivery of the Advanced Lightweight Thermal Bus protoflight model in FY02.

Technology barriers for space thermal management include rapid, reliable startup and long-term operation of capillary-pumped loop systems and loop heat pipes; and development of (1) low-cost, advanced composite materials and devices capable of dissipating high heat fluxes from microelectronics devices, (2) sub-micron wicks (1-micron pore size) for capillary-pumped loop applications, and (3) flexible or rotatable joints that allow for the efficient transportation of heat from the space vehicle bus outboard to a deployable radiator.

Thermal management is considered a pervasive technology area, applicable to all space vehicle program offices. The technologies are essential for those missions with either high-power dissipation (SMC or SAF/SP space-based radar) or concentrated power dissipation on reduced area payloads (next-generation military and commercial communication space vehicles such as MILSTAR III, as well as the NPOESS program with a multitude of weather sensors).

Service/Agency POC	USD(A&T) POC	Customer POC	DUSD (Space) POC
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	8809	2.6	2.6	2.6	2.8	2.9	0	0
0603401F	682J	0.8	0.7	0.6	0.6	0.7	0	0
	Total	3.5	3.2	3.2	3.4	3.6	0	0

Note: Totals may not add due to rounding.

SP.03.06 ***Space Structures and Control***. This project will develop advanced space structural component technology to reduce the weight and cost of spacecraft and launch vehicle structures while improving their producibility and reliability; and will develop enabling structural sensing, control and vibration damping technologies for space platforms, precision surveillance sensors, space-based radars, space-based interceptors, missiles, and launch systems. This includes the development of a new class of adaptive or smart structures, which contain sensors and actuators to sense and suppress vibrations to meet mission requirements; the development of new mechanism concepts, such as nonpyrotechnic release devices; and new structural response sensors, such as advanced, multiplexable fiber optics sensors based on Bragg technology. In addition, there is exploratory research into the development of new structural control algorithms and into new approaches for determining the structural response characteristics of a space system on orbit. Structural control and vibration damping technologies are pervasive and support a wide range of commercial and military customers including all DoD spacecraft program offices as well as USSPACECOM, NAVSPAWARS, NASA, and other agencies.

Specific demonstrated capabilities and milestones for advanced structural control technology concepts, techniques, and production approaches are to reduce satellite structural mass by 35% and reduce cost by more than 10% by FY01 (70% and 25%, respectively, by FY11); to reduce ELV launch vehicle structural subsystem mass by 40% and cost by 40% by FY01 (75% and 75%, respectively, by FY11); decrease satellite dynamic launch loads by a factor of 5 by FY01 (a factor of 10 by FY11); demonstrate flight-qualified, fiber-optic sensors by FY00; and decrease on-orbit disturbances experienced by payloads by a factor of 10 by FY01 (a factor of 50 by FY11).

Technical challenges include developing rapid and less costly manufacturing techniques for large launch vehicle structures; accounting for the synergistic effects of the combined aspects of the space environment; developing high-fidelity simulations; reducing EMI effects and increasing the reliability/durability of multifunctional structures; ensuring satellite structural isolation without constraints on rattle space (clearance), weight, power, and volume, as well as interaction between the isolator control system and the launch vehicle control system; developing rapid nonpyrotechnic release mechanisms; and integrating neural network technology into structural control systems during operation. The technical approaches are focused on researching new structural concepts and construction methods to decrease the weight and cost. This technology improves the conductivity and radiation shielding capability of satellite bus and secondary structures. The project encompasses investigating new techniques to better understand and predict the effects of the space environment on spacecraft structures; and integrating power, communication, and electrical paths into the structure thus eliminating the need for wiring harnesses, connectors, and electronic boxes.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	**DUSD (Space) POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	8809	3.2	3.1	3.1	3.4	3.5	3.6	3.8
0603302F	0003	0.6	0.6	0.6	0.6	0.7	0.7	0.7
0602234N		0.4	0.5	0.5	0.5	0.6	0	0
0603401F	1026	0.6	0.9	1.3	1.6	2.0	2.1	2.2
Total		4.8	5.1	5.6	6.2	6.8	6.4	6.6

Note: Totals may not add due to rounding.

SP.05.06 ***Large Precise Structures***. This DTO develops lightweight optical structures and associated sensor technologies for space deployment. Applications include surveillance from space, directed-energy weapons, and communications. Currently, the main thrust is to develop and demonstrate emerging technologies required for affordable large-aperture, space-based telescopes. The customers are AFSPC/DR, 21st Space Wing USSPC, and other agencies.

Specific demonstrated capabilities and milestones are, by FY98, demonstration of key optics, structures, structural control, and signal processing technologies, and their integration in the New World Vistas-initiated Compensated, Large Lightweight Space Optics Program; a laboratory evaluation of integrated system performance will begin in FY98. This program will demonstrate the performance of a revolutionary approach to a large-aperture, high-resolution, space-deployable imaging system which will reduce optics payload weight by at least 50%, and launch cost proportionally. It will demonstrate space sensor technologies required for very large aperture, long-dwell systems used for global awareness.

Key technology challenges and developments include extremely lightweight large apertures such as dilute and inflatable optics, space-erectable structures, nonconventional wavefront compensation for maintaining good image quality, and smart sensor technologies for on-board processing. Specifically, dilute aperture phasing, nonlinear optical techniques, biomemonics for on board processing, and phase diversity will be evaluated. The integrated performance of deployable space structures, ultra lightweight optics, and nonconventional compensation systems will be evaluated using image quality, information delivery, and packaging efficiency as metrics.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	3326	2.3	3.1	3.1	3.1	3.2	0	0
	Total	2.3	3.1	3.1	3.1	3.2	0	0

SP.08.06 ***Space Power System Technologies.*** This project will develop, demonstrate, and transition space power generation, storage, and management technologies to significantly enhance the capabilities and on-orbit life of space vehicles and missions. It incorporate solar photovoltaic array designs, solar thermal conversion subsystems, high specific energy batteries (NaS, Li ion), flywheels, high-voltage converter and solid-state switch components, and advanced wide-bandgap semiconductors to provide high-efficiency energy conversion and increased usable power to on-orbit space vehicles.

Demonstrated technology goals for an integrated space power system include increased subsystem conversion efficiency from current level of 18.5% to a level of 28% by FY00 and to 35% by FY05; increased solar array specific power from the current level of 50 W/kg to 100 W/kg in FY00, and further to 120 W/kg in FY05 (LEO); and increased LEO satellite energy-storage-specific energy density from the current 40 Wh/kg to 100 Wh/kg by FY00, and 150 Wh/kg in FY05. Technology payoffs are increased payload mass fraction, increased available usable power, and increased space vehicle on-orbit life using weight savings which may be applied to the station-keeping propulsion system.

Milestones for space power system technologies include: in FY00, development of a solar thermal power generation system, demonstration of high efficiency solar cell manufacturing techniques, and protoflight testing of nonelectrochemical energy storage devices; and in FY02, development of concepts for the Advanced Concentrator Follow-on Program. Space flight demonstrations are planned on the STRV–2 Program STP–5 and MightySat I in FY97.

Technical barriers include growth and compatibility of advanced semiconductor materials ($GaInP_2$, GaAs, $ZnGeAs_2$, $CuInSe_2$) for multijunction and low-cost, ultra-thin solar cells; feasibility of high-efficiency solar thermal conversion through a combination of devices, concentrators, and power distribution systems; inability to predict the effects of battery cell design and electrochemical processes on optimum operating conditions, battery performance, and cycling lifetime; availability of high-voltage (70–130 Vdc), space-qualified, silicon-based, solid-state components and circuits; and availability of higher efficiency wide-bandgap (GaAs and SiC), solid-state devices.

Space power generation is a pervasive technology area, applicable to all space vehicle program offices. The technologies are essential for those missions with either high-power level or concentrated power usage payloads (next-generation military and commercial communication space vehicles such as MILSTAR III, as well as the NPOESS program.)

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	**DUSD (Space) POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	8809	3.4	3.5	4.9	4.4	3.4	0	0
0603401F	682J	3.1	2.8	3.2	4.0	5.3	0	0
0603173C	1270	3.0	0.1	0	0	0	0	0
0602715H	AX	8.0	8.1	8.1	0	0	0	0
	Total	17.5	14.4	16.3	8.3	8.6	0	0

Note: Totals may not add due to rounding.

SP.09.01 *Satellite Control.* This DTO develops and integrates satellite control technologies for the Air Force Satellite Control Network (AFSCN) to provide autonomous ground and space operations, portable ground operations and data dissemination, and advanced operator environments for satellite control. This effort emphasizes the development of systems with increased operational capability and low acquisition and maintenance costs. Enhanced capability is achieved by providing immediate information to the warfighter through portable systems and providing a continuous upgrade process with flexibility so changing requirements can be easily satisfied.

These technologies provide for a reduction in instructor manpower requirements of 50% by FY00, a further reduction of 75% by FY05, a reduction in control costs (with an increase in capability) by 30% in FY00, and 40% by FY05 and 60% in FY10. Decision support for anomalies will be added in phases through FY99; on-board autonomous satellite health and status capability will be flight tested in FY02, machine learning systems in FY04, and immersive operator environments in FY05.

Technology challenges include the verification of the correctness and safety of automated anomaly detection and resolution based on artificial intelligence techniques such a neural networks; the development of reliable, verifiable, self-learning computer systems; reducing the processing and storage requirements of autonomous systems so they can be used on-board the satellite; developing generic intelligent systems that can be used on more than one satellite family; verifying correct performance of highly intelligent ground and space systems; and developing technologies that will satisfy acquisition and O&M cost constraints. Users include USAF Space Command, USAF Space and Missile Systems Center SPOs, and select Navy, BMDO, and other agencies.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	**DUSD (Space) POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	8809	2.4	3.0	3.1	3.3	3.4	3.6	3.7
0603401F	2818	2.6	2.9	3.2	3.4	3.6	3.7	3.9
	Total	5.0	5.9	6.2	6.6	7.0	7.3	7.6

Note: Totals may not add due to rounding.

SP.10.06 ***Boost Propulsion (ET).*** This program will demonstrate advanced spacelift propulsion capabilities for military and nonmilitary space launch systems to enhance low-cost, high-performance, responsive access to space for expendable or military multiuse vehicles via improved designs, combustion technologies, and material advancements; and develop and demonstrate solid, liquid, and hybrid propulsion systems for military, civil, and commercial applications. Future space launch systems will require full-flow staged combustion, increased chamber pressures, reduced part count, and advanced materials (including functionally graded material technologies and oxidation-resistant materials) in order to maintain the U.S. global presence capability through enhanced strategic agility.

Specific demonstrated capabilities for liquid cryogenic propulsion systems include payload increases of 68% with cost reductions (in dollars per pound to orbit) of over 50% by FY00. By FY05, cryogenic propulsion system demonstrations will attain 121% payload increases with cost reductions of 78%, and hydrocarbon demonstrations will attain payload increases of 50% with 28% cost reductions. FY00 liquid spacelift propulsion demonstrations will achieve specific improvements of –25% failure rate, +5 sec Isp, –15% hardware costs, –15% support costs, +30% thrust/wt, and 20-mission life (mean time between removal for reusable systems). Specific demonstrated capabilities for solid and hybrid propulsion systems include payload increases of 7% with cost reductions of 12% by FY00. By FY05, solid demonstrations will achieve payload increases of 13% with 20% cost reductions. FY00 solid/hybrid boost propulsion demonstrations will achieve specific improvements of –25% failure rate, +15% mass fraction, +5 sec Isp, –15% hardware costs, and –15% support costs.

Milestones for liquid boost propulsion include: by FY97, completion of the hydrostatic bearing tests for integration of the bearings into the Integrated Powerhead Demonstration in FY98 (increasing engine thrust/weight by 10%), with the engine demonstrations to begin in FY99. By FY97, thrust cell rapid prototyping techniques will be demonstrated (for significant design cost reductions). Milestones for solid boost developments include: by FY97, scale-up demonstration of high-temperature solid components (capable of withstanding higher combustion temperatures from new propellants) in a SuperBATES size motor, and high-performance environmental propellant ingredient scale-up and demonstrations (through FY98).

Technical challenges for liquid systems include improving material compatibility, reducing component weight and volume through the incorporation of advanced materials, increasing rotodynamic speeds (to decrease turbo pump assembly size), increasing turbine blade/disk capability of withstanding thermal shocks and high stresses at high temperatures, reducing composite processing costs, utilizing advanced bearing concepts, and identifying advanced bearing concept limitations. Solid system technical challenges include adapting polymeric materials for use in manufacturing reduced weight components, eliminating bondlines, and identifying high-strength case materials for decreased component mass/volume.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	1011	24.4	18.1	24.3	24.5	24.0	24.3	27.1
0603302F	4373	14.0	11.8	11.8	12.8	11.4	10.2	11.1
Total		38.3	29.9	36.1	37.3	35.3	34.5	38.2

Note: Totals may not add due to rounding.

SP.11.06 ***Orbit Transfer Propulsion AT.*** This DTO will demonstrate individual orbit transfer propulsion capabilities that significantly enhance low-cost, high-performance access to space via revolutionary propulsion techniques with improved designs, combustion and mixing technologies, and material advancements; and will develop and demonstrate chemical, high-power solar electric, and solar thermal propulsion systems for military, civil, and commercial orbit transfer applications. Future orbit transfer systems will require advanced materials, low-cost power processing developments, and increased thruster efficiency in order to maintain the U.S. global presence capability through enhanced strategic agility.

Specific demonstrated capabilities for chemical orbit transfer systems include an increased payload capability of 10% in FY00 and 20% in FY05. Solar thermal orbit transfer systems will demonstrate, by FY00, life and repositioning capabilities leading to $60 million in launch and lifespan cost savings. FY00 chemical/solar thermal orbit transfer propulsion demonstrations will achieve specific improvements of +10% Isp, and +15% mass fraction. Specific demonstrated capabilities for solar electric orbit transfer propulsion systems include increased repositioning capabilities doubling that of current systems, or life and payload increases leading to a $60 million launch cost savings. FY00 solar electric orbit transfer propulsion demonstrations will achieve specific improvements of +15% mass fraction and +15% thruster efficiency in FY00.

Milestones for orbit transfer propulsion include chemical thrust chamber assembly proof testing and hardware completion in FY97 for integration into the FY00 chemical upper-stage/orbit-transfer demonstration, Argos spacecraft launch for the ESEX high-power (30 kW) arcjet demonstration in FY97, and solar thermal propulsion system design complete in FY99 for balloon flight test in FY00.

Technical challenges/barriers include chemical combustion and mixing improvements for increased combustion efficiency, lightweight material developments to improve mass fraction in chemical systems, solar thermal concentrator (and absorber) design and deployment improvements to enhance reliability, refined solar thermal tracking capabilities, and increased solar electric power processing and thruster efficiency to reduce weight, increase performance, and increase reliability.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	1011	5.8	2.5	2.1	3.4	5.6	5.9	4.2
0603302F	4373	0.8	2.3	4.0	3.6	5.0	7.2	7.0
	Total	6.6	4.8	6.1	7.1	10.6	13.1	11.2

Note: Totals may not add due to rounding.

SP.13.06 ***Tactical Rocket Propulsion AT.*** This DTO demonstrates advanced tactical rocket propulsion capabilities for military systems to significantly enhance joint service lethality through long-range, highly maneuverable tactical rockets via improved designs, combustion technologies, and material advancements; and develops and demonstrates solid, gel, and hybrid propulsion systems for military (air-to-air, surface-to-air, etc.) applications. Future tactical rockets will exploit advanced materials including functionally graded material technologies to maintain the U.S. global presence capability through enhanced strategic agility and lethality.

Specific demonstrated capabilities for all tactical rocket propulsion systems include a 10% increase in warhead size or range, or a 20% decrease in time-to-target, by FY00. Divert propulsion systems will demonstrate a 26% reduction in the number of interceptors required (per theater) by FY00. FY00 tactical rocket propulsion demonstrations will achieve specific improvements of +3% delivered energy, +10% mass fraction (with TVC), and +2% mass fraction (without TVC), while maintaining current cost/safety/survivability standards.

Milestones for tactical rocket propulsion include formulating and testing a GAP/AN/CL20 propellant by FY97, evaluating a low-cost carbon-carbon nozzle by FY97, and integrating the nozzle and propellant for testing in FY97. Once successful, these components will be scaled up for integration into the IHPRPT program's FY00 high-performance, increased-range tactical propulsion demonstration.

Technical barriers revolve around two primary areas: propellant developments and component developments. Propellant technical challenges/barriers include reducing detonability while increasing performance in high-energy propellants, enhancing burn-rate control, and investigating high-energy smokeless ingredients. Component technical challenges/barriers involve adapting polymeric materials for use as reduced weight components, eliminating bondlines, and identifying high-strength case materials for decreased component mass/volume. Hybrid concepts are advantageous with respect to throttling and combustion control issues but are currently limited by their bulky, lower performing designs. Advanced materials will allow for new hybrid designs to be investigated. High-energy-fuel/-oxidizer developments are also required for hybrid tactical missiles to be exploited.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	1011	3.7	2.9	3.1	3.1	3.0	2.7	2.6
0603302F	4373	0.3	0.3	0.3	0.3	0.3	0.3	0.4
0602303A	A214	2.9	2.8	3.2	3.2	0	0	0
0602111N		3.0	3.5	3.4	2.9	0	0	0
0603792N	R1889	11.2	9.0	5.0	0	0	0	0
	Total	21.2	18.4	15.0	9.5	3.3	3.1	3.0

Note: Totals may not add due to rounding.

SP.15.06 ***Protection Technologies.*** The goal is to develop and demonstrate technologies required to assure operation of U.S. space assets in both the natural space environment and the hostile warfighting environment. Specifically, the program will evaluate through high-fidelity subsystem and system models the effects of the threats on U.S./allied space systems, and then develop and demonstrate the efficacy of multithreat protection techniques against those threats.

The technical approach includes definition of the threat (hostile and natural—including space debris); developing program protection requirements with users; performance of susceptibility and vulnerability experiments at various levels of integration; development of models or analytic techniques for extrapolating data to higher levels of system interaction; performance of survivability enhancement options trades; development of protection techniques based on those performance trades; and demonstration of those techniques on appropriate subsystems.

Specific milestones for protection technologies include a reduced radiation safety factor for current COTS components from a factor of 10 to a factor of 5 by FY00, a factor of 4 by FY05, and a factor of 3 by FY10; laser threat protection increased by a factor of 2 by FY00, a factor of 5 by FY05, and a factor of 10 by FY10; RF high-power microwave susceptibility from a current level of 40 dB to 15 dB in FY00, 10 dB in FY05, and 6 dB by FY10; increased knowledge of space debris from the current shuttle baseline by a factor of 5 by FY00, a factor of 10 by FY05, and a factor of 25 by FY10. Demonstration of the laser microbolometer and RF detector will occur in FY01.

Technical barriers include accuracy of the threat/subsystem interaction modules; accuracy of space debris prediction models; integration of threat-specific modules into multithreat prediction models; minimization of performance impact of threat countermeasures; and integration of balanced multithreat protection capability.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	**DUSD (Space) POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	5797	1.4	1.5	1.4	1.5	1.5	1.5	1.4
0603401F	4400	2.3	0	0	0	0	0	0
0603605F	3152	1.0	1.5	1.6	1.6	1.6	1.7	1.8
0603112F	2100	1.1	0.5	0.1	0	0	0	0
0603771F	3095	1.5	0.3	0	0	0	0	0
0602102F	4347/8	0.5	0.2	0.2	0.2	0.2	0.2	0.2
0603410F	2822/3	0	0.3	1.0	1.7	2.4	2.9	3.0
0602601F	1010	0	0.1	0.6	0.6	0.6	0	0
	Total	7.7	4.4	4.9	5.6	6.4	6.4	6.5

Note: Totals may not add due to rounding.

SP.16.06 ***Threat Warning and Attack Reporting.*** This DTO develops on-board sensor technologies to monitor, detect, identify, locate, characterize, and report a threat against critical U.S./allied satellites; and demonstrates innovative, lightweight, low-power, miniaturized, and cost-effective electro-optical, RF sensors, advanced microelectronics, and communication technologies.

The technical approach includes definition of the warfighter requirements by working with USSPACECOM; characterization of the threat environment as a function of time; investigation of candidate sensor and microelectronics technologies; and development and demonstration of candidate technologies which can be transitioned to SPOs.

Given the current technology baseline (135 lb and 110 W), specific demonstrated capabilities for a threat warning and attack reporting on-board system include a brassboard of a microbolometer laser detector in FY99 and a space demonstration in FY01 with weight reduction by a factor of 4 and power reduction by a factor of 3 in the RF sensor with associated electronics. This system will geolocate a threat. Follow-on activities to achieve an integrated laser/RF sensor suite with a weight and power reduction of a factor of 10 and a factor of 5, respectively, will commence in FY04.

Technical barriers include the use of a single laser detector (microbolometer) to achieve required bandwidth and dynamic range for pulsed and counter weapon sources; use of a cross-correlation receiver for RF threat detection; and miniaturization of the antennas and associated electronics to meet stringent weight and power goals.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	**DUSD (Space) POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603401F	4400	1.8	0.5	0	0	0	0	0
0603410F	2823	0.3	0.3	0.2	0.1	0.1	0	0
	Total	2.0	0.8	0.2	0.1	0.1	0	0

Note: Totals may not add due to rounding.

SP.19.06 ***Technology for the Sustainment of Strategic Systems.*** USSTRATCOM developed a list of critical science and technology issues to sustain the national strategic system capability. The USSTRATCOM critical issue areas addressed in this DTO are boost propulsion, post-boost vehicle (PBV) propulsion, and missile system aging and surveillance.

The objectives of these efforts are to develop a class 1.3 solid propellant that meets all ballistic missile propulsion requirements—as well as the associated propulsion system components that are compatible with that propellant—by FY01; extend the "look ahead" window 10 years by FY00 and 20 years by FY10 with a 90% confidence level; reduce the time and cost for nondestructive evaluation (NDE) data processing by 50% by FY05; and develop and demonstrate PBV control system component technologies using commercially available materials by FY04.

The technologies being developed address critical component/ingredient availability; sustaining critical design, test, and manufacturing capabilities; and increasing system life, availability, and affordability. The technical challenges include developing non-shock-sensitive, high-energy propellant ingredients that will yield the required Trident ballistic performance while meeting the strategic missile service life requirements; identifying commercially available, high-temperature/high-strength materials that meet the Trident PBV operational requirements and can be manufactured using commercially available techniques; identifying effective seal materials for the Minuteman PBV propulsion system; and developing a better understanding of propulsion system chemical kinetics that can be linked with NDE techniques and service life prediction codes to increase missile propulsion service life prediction confidence by 100%.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	1011	0	6.0	7.0	7.0	7.0	7.0	5.4
0602111N		0	0	1.0	1.0	1.0	0	0
0603302F	4373	3.0	3.0	3.0	3.0	3.0	3.0	3.0
0603302F	6340	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Total	4.0	10.0	12.0	12.0	12.0	11.0	9.4

HUMAN SYSTEMS

HUMAN SYSTEMS

HS.01.00 ***Advanced Aircrew Escape.*** This DTO will develop and demonstrate technologies to provide safe ejection at adverse attitude, low altitude, and airspeeds up to 700 kn for an expanded range of aircrew size and weight. The critical technologies to achieve the objective are controllable propulsion, digital flight control system, and high-speed windblast protection. Products will be transitioned to USAF and USN aircraft and will be applicable to the improvement of current ACES II and NACES ejection seats and to a fourth-generation escape system. Foreign technology (Russian K–36 ejection seat) will be exploited. Other contributing technologies include biodynamic modeling and simulation. Potential target aircraft for advanced aircrew escape systems include the JSF and F–22. Payoffs are decreased aircrew fatalities and injuries, escape capability throughout the flight envelope, full aircrew accommodation, and reduced life-cycle costs. By FY97, the program will demonstrate safe escape up to 700 kn. By FY98, the program will transition fourth-generation technology to system program office. By FY99, the goal is to demonstrate a full-accommodation-seat prototype; and by FY00, to initiate a joint USAF/USN EMD program.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602202F	7184	2.3	2.3	2.4	2.4	2.1	0	0
0603231F	2830	6.2	6.5	7.3	7.7	8.2	0	0
	Total	8.5	8.8	9.7	10.1	10.3	0	0

HS.02.06 ***Advanced Hybrid Oxygen System.*** This DTO will develop and demonstrate technologies capable of generating and liquefying high-purity oxygen using electrical power or aircraft engine bleed air, eliminating the requirement for stored liquid oxygen or transporting oxygen production equipment to the war zone. This advanced technology program contains two individual developments, one targeted for heavy aircraft applications (Advanced Hybrid Oxygen System–Aircraft), and a smaller, portable unit for aeromedical evacuation and field casualty care operations (Advanced Hybrid Oxygen System–Medical). In this program, critical technologies include turbomachinery, heat exchangers, concentrators, and integration and automation issues.

Payoffs of this technology include extending the operating range of aircraft, reducing aircraft sortie turnaround time and, in both aircraft and medical applications, significantly reducing the cost and logistical burden associated with existing LOX/GOX systems. Program milestones include technology transition of the portable medical system at the end of FY97, and the transition of the aircraft system by the end of FY01.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603231F	2830	1.5	1.1	2.0	2.1	2.3	0	0
	Total	1.5	1.1	2.0	2.1	2.3	0	0

HS.03.06 ***Aircrew Distributed Mission Training Technology.*** By FY98, this DTO will develop, demonstrate, and evaluate affordable training technologies to improve aircrew training capability in local and geographically distributed modes of multiaircraft formations. The program will develop and demonstrate an aviation training strategy that makes the most effective use of simulators, training devices, and live exercises for initial flight skills through unit combat tasks. In FY97, the DTO will develop next-generation advanced simulation for multirole aircrews allowing operational/tactics test and evaluation, and establish minimum fidelity requirements for critical aircrew skills training that will decrease the cost of providing high-fidelity simulation systems by 75%. By FY98, the goal is to develop and demonstrate a multirole aircrew simulation testbed, integrating four advanced simulation cockpits with next-generation visuals in 360-deg displays, with an advanced control station and threat systems that will increase pilot capability to conduct air superiority missions by 30%, close air support missions by 25%, and interdiction missions by 35%.

Service/Agency POC
COL Gary D. Zank
AR/HR
DSN 240-2665

USD(A&T) POC
Dr. A. Johnson-Winegar
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Customer POC
COL Steve Robertson
Air Combat Command
DSN 574-7821

Col Edward Littlejohn
TRADOC,USAAVNC
Aviation Trng Bde
DSN 464-7555

Capt Ray Morris
NAVAIR, PMA205
DSN 664-2245

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603227F	2743	4.1	3.6	0	0	0	0	0
0602785A	791	1.9	0	0	0	0	0	0
0603007A	793	0.4	0	0	0	0	0	0
0602785A	790	0	2.2	0	0	0	0	0
	Total	6.4	5.8	0	0	0	0	0

HS.04.06 ***Authoring Tools for Adaptive Training Systems.*** This DTO will develop authoring tools for computer-based (CB) adaptive individual and group training systems which reduce the cost of military classroom instruction by 25%; reduce the development time by 90% and cost by 80% for authoring multimedia individual and distance learning courseware in standard and virtual environments (VE); decrease the author training requirements to less than 3 days; and increase the learning efficiency of the courseware by one standard deviation. In FY95, a prototype demonstrated increased authoring efficiency of CB maintenance training by 90%. In FY96, the feasibility of importing Interactive Electronic Technical Manual (IETM) data into the software was demonstrated with training development time savings over 95%. (Note: IETM data are available for increasing numbers of weapon system modifications and will be available for all F–22 systems.) In FY97, intelligent authoring tools for VE training will be demonstrated. In FY98 and FY99, several prototypes will be transitioned. In FY00, student learner models, which produce increased learning up to two SDs in laboratory settings, will be imbedded in authoring tools and tested; those tools will be transitioned to the field in FY01.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
Col Zank AL/HR DSN 240-2665	Dr. A. Johnson-Winegar Dir. E&LS (DDR&E) DSN 227- 8714	Air Combat Command 372nd Training Squadron AF Special OPS Command AFSOC/XPOT 720th Special Training Group Air Intelligence Agency AIA/DOMR Air Education & Training Comm AETC/XOR Dr. Dennis Richberg SES DSN 969-2005

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602202F	1123	1.7	1.7	1.6	1.8	1.7	0	0
0603227F	2949	1.4	1.3	1.4	1.5	1.5	0	0
	Total	3.1	3.0	3.0	3.3	3.2	0	0

HS.05.05 ***Ballistic Protection for Individual Survivability.*** This DTO will develop and insert advances in materials technology to increase the protection and performance of armor systems for the individual warfighter while minimizing penalties associated with the increased levels of protection. By FY98, the program will demonstrate an advanced material system for protection against combined fragmentation and small arms threats (known ball threats up to .30 caliber), to be measured by a 20–30% reduction in areal density (weight for given area) over current small arms protection without significantly increasing other penalties. By FY99, the goal is to integrate and transition improved technology to advanced development or as technology insertions to modify existing individual protective systems. The FY00 goal is to transition to advanced development protective materials technology providing protection equal to the FY96 individual countermine protective system at a 35% reduction in system weight. By FY03, the program will demonstrate an improved material system prototype for second-generation multiple ballistic threat protection (with either an additional 10% decrease in weight, a 10% increase in protection, or a combination, depending on user assessments).

Technical barriers include physical property limitations of current high-performance ballistic protective materials; excess weight, thickness, and cost; rigidity of materials; and manufacturing methodology. Technologies with the potential to satisfy these objectives include advances in polymeric materials through modification of existing fibers (copolymerization of aramid, PBO), bioengineered protein-based fibers, and synthesis of new polymers. Improved rigid materials are anticipated through DARPA, Army, and industry programs. These could include low-cost, high-performance boron carbide, new metal alloys, metal-matrix composites, and potential new materials with modified defeat mechanisms.

This DTO supports JWCO Military Operations in Urban Terrain, Joint Readiness and Logistics, and Joint Countermine. Technologies will benefit emerging systems as well as fielded systems, including Force XXI Land Warrior, Land and Air Warrior, Modular and Ranger Body Armor, Personnel Armor for Ground Troops Vest and Helmet, Body Armor Set Individual Countermine, and Inconspicuous Body Armor.

Service/Agency POC	**Lab/Center POC**	**USD(A&T) POC**	**Customer POC**
Mr. P. Brandler Director, NRDEC DSN 256-4700	Mr. W. Goodwin, Jr. NRDEC DSN 256-4538	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	COL Bosse Dismounted Battle Space Battle Lab ATSH-IWC DSN 835-2310

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602786A	AH98	1.3	1.0	1.1	1.2	1.1	1.4	1.5
	Total	1.3	1.0	1.1	1.2	1.1	1.4	1.5

HS.06.01 ***Cognitive Engineering for Battlespace Dominance.*** This DTO will demonstrate flexible/robust operator interfaces and performance-aiding subsystems for integration into information processes and functions to ensure achieving and maintaining battlespace awareness and tactical dominance. It supports execution of time-critical missions through consistent situation awareness of the battlespace. The program provides operator-aiding subsystems and interfaces to support joint information superiority, precision force, combat identification, electronic warfare, and information warfare operations.

Specific demonstrated capabilities for the DTO include advanced crew systems for assisted target acquisition which reduce system false alarm rates by at least 30%; performance-aiding intelligence, surveillance, and reconnaissance (ISR) subsystems which support multi-source fusion and which reduce missed target rates by 15% in the face of enemy deception and denial practices; reduce crew size requirements by 80% for theater ISR systems; and cut crisis response planning/battlespace management timelines by 50%.

Milestones include drafting standard performance metrics and demonstrating them in Army Task Force Exercise '97, and drafting performance-based design standards and demonstrating them in the Division '98 Field Exercise. During FY97, an advanced image analyst workstation will be flight demonstrated on an E–8C JSTAR aircraft. By FY99, real-time operations models of tactical situation awareness and assessment will be embedded in decision support systems and evaluated. By FY01, collaborative, perceptual, and physical task-aiding models and architectures will be demonstrated and evaluated in stressful military environments.

Technical barriers include robust models of critical thinking, problem solving, and tactical decision making; high-bandwidth, multisource communications links; high-efficiency data compression algorithms; high-speed, intelligent data retrieval agents; robust algorithms for assisted target recognition; high-resolution, multimedia display interfaces; and robust virtual environment interfaces.

Service/Agency POC	USD(A&T) POC	Customer POC	
Mr. James Brinkley AL/CF DSN 785-2678	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	Col P. Garvey ACC/DRA DSN 574-5201	Maj R.Lewis ASC/DRAC DSN 574-8656
Mr. Jeffrey Grossman NCCOSC/NRaD DSN 553-9625		LtCol R. Fennel ASC/LAAT DSN 785-1230	Capt M. Winslow OPNAV N-6 DSN 224-4770
		Maj Ritch Rodebaugh Marine Corps Battle Lab DSN 278-5177	

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602716A	AH70	0.3	0.3	0	0	0	0	0
0602233N		1.4	1.3	1.2	1.3	1.3	0	0
0603707N	L1771	1.9	1.9	2.0	1.9	2.0	0	0
0602202F	7184	2.1	2.0	2.0	1.9	1.6	0	0
	Total	5.7	5.5	5.2	5.1	4.9	0	0

HS.07.06 ***Crew Station Integration Demonstrations.*** This DTO is intended to advance the state of the art in aircraft crew station integration technology. It will demonstrate in full operational context that crew-centered methods, metrics, and tools can be synergistically integrated to improve crew performance throughout the platform's operational envelope, thus impacting mission effectiveness, suitability, affordability, and safety. Strategic technology goals are to integrate helmet displays with speech recognition, large-format head-down displays, and pictorial graphics leveraging human capabilities to achieve acceptable single-seat cockpit workload levels equal to or better than current systems, when the warfighter has to make mission adjustments in response to rapidly changing combat conditions. The main technology challenge is to minimize task "shedding" by combat aircrews during high stress and time-constrained operations, permitting operations with reduced crew size to achieve the attendant affordability gains. During FY97, the program will demonstrate the integration of target acquisition sensing/ processing/display/control capabilities in the F–15E Strike Eagle and in the Roving Sands/Joint Project Optic Cobra '97. The goal is to show a 30% increase in target acquisition range, achievable via effective sensor and crew system integration, while decreasing crew workload and enhancing crew situation awareness. Also during FY97, this DTO will complete the analysis and laboratory simulation of a U–2 cockpit upgrade, showing the ability to generate quantitative crew system data for the requirements community to use in preparing mission need statements and operational requirements documents. Current practice does not produce quantified crew station requirements to guide development. During FY98, the program will flight-demonstrate a new ability for target identification from standoff surveillance ranges, attributable to the integration of the crew stations with an enhanced synthetic aperture radar (ESAR) and assisted target recognition in the E–8C JSTARS aircraft. The FY01 goal is to demonstrate a 50% reduction in aircrew workload attributable to effective crew station integration, enabling single-seat, air-to-ground precision weapons delivery at night and in adverse weather.

Service/Agency POC	USD(A&T) POC	Customer POC	
Mr. James Brinkley AL/CF DSN 785-2683	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	Ms. Shirley Morrison ASC/FBXT DSN 785-1230	Maj Robert Braun ACC/DRAO DSN 564-7067
Dr. Keith Richey WL/FI DSN 785-3900		Col Bruce Queen SAF/AQI DSN 227-9957	Maj Carl Trout ASC/RA DSN 785-4785
		Maj Mark O'Hair SAF/AQIJ DSN 225-6242	Col Jay Baird ACCSO-A DSN 785-5291

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602202F	7184	0.6	0.7	0.6	0.5	0.4	0	0
0603231F	2829	1.1	0	0	0	0	0	0
0603231F	2830	0	0	0	0	0	0	0
0602201F	2403	0.6	0.5	0.5	0.5	0.4	0	0
0603205F	2978	0.2	0.4	0.6	0.4	0	0	0
0603245F	2568	0	0	0	1.4	1.8	0	0
	Total	2.4	1.6	1.7	2.8	2.6	0	0

Note: Totals may not add due to rounding.

HS.08.06 ***Crew System Engineering Design Tools.*** This DTO provides the building blocks for a new design technology applicable to all defense acquisition programs where crew system interface is key, in the form of software-based engineering design tools. Technical objectives include establishing crew/system interface design principles, electronic databases, and computational models that enhance the warfighter's interface with equipment; and transitioning reliable methods for assessing the impact of new technologies and specific battlefield environments on crew performance and vulnerability. By FY97, the program will transition a PC-based software tool for planning, analyzing, and visualizing data and for performing crew system flight test programs. By FY98, the goal is to complete a five-stage demonstration of an integrated suite of workplace design tools, including a user-tailorable on-line system engineering process for design and software tools for analysis and rapid prototyping, and featuring a ground-based real-time simulator for design evaluation. Beta testing of PC-based software tools for managing design traceability and timeline analysis will be completed by FY98. By FY99, the program will develop and demonstrate an anthropometric information system containing high-fidelity 3D images of NATO populations for improved fit and safety. By FY99, the goal is to develop interactive, graphical man-models of human physical fit and performance integrated with CAD/CAE processes. By FY02, the program will demonstrate and validate a software toolset for performing tradeoff analysis of complex automation through analytical mission simulation. Overall objectives of this DTO are to reduce the time needed to develop the crew system by 50%, reduce design-induced crew errors by 75%, and reduce the need for crew station redesign at the test and evaluation stage by a factor of ten.

Service/Agency POC	USD(A&T) POC	Customer POC	
Mr. James Brinkley AL/CF DSN 785-2678	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	LtCol C. Snead AF/XOM DSN 763-5342	Col Jay Baird ACCSO-A DSN 785-5291
Mr. David Weller AMSAT-R-N DSN 693-1070		Mr. Russ Lenz 412TW/TSS 805-275-9242	Mr. Dave Britton ASC/ENSC DSN 785-8596
		Col Porter ATSH-MW DSN 464-8247 (Mounted Battlespace Battle Lab)	Mr. Thomas Metzler SFAE-AV-LSE DSN 693-9146

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602716A	AH70	0.4	0	0	0	0	0	0
0602202F	7184	5.8	6.0	6.0	6.0	5.3	0	0
0603231F	2829	0.5	0	0	0	0	0	0
	Total	6.7	6.0	6.0	6.0	5.3	0	0

HS.09.06 ***Development of Advanced Embedded Training Concepts for Shipboard Systems.*** The objective is to develop and demonstrate an Advanced Embedded Training Capability to improve CIC team decision-making performance by 25–40%, reduce training time by 40%, and reduce the number of required instructors by 50%. The system will automatically track team member behavior, assess performance, provide on-line feedback, and facilitate computer-assisted coaching. In FY96, initial enabling technologies (eye tracking, keystroke recording, speech recognition, human performance modeling) will be applied, integrated, and demonstrated on a single watchstation. In FY97, automated diagnostic routines and system-generated feedback mechanisms will be integrated into the system, and a team-level demonstration will be completed. The final operational demonstration will be conducted, and initial transition plans to Aegis and the Battle Force Tactical Trainer (BFTT) finalized in FY98.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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OPNAV N91	Dir., E&LS (DDR&E)	EO (SC)
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	4.0	4.0	0	0	0	0	0
	Total	4.0	4.0	0	0	0	0	0

HS.10.05 ***Force XXI Land Warrior.*** By the end of FY98, this DTO will perform an early user test (EUT) to validate improvements to advanced component technologies for the Land Warrior (LW) system. Force XXI Land Warrior (FXXILW) will demonstrate the improved individual and small-unit operational effectiveness afforded by the modular integration of advanced components onto the LW platform. The FXXILW program also will perform risk reduction efforts in support of the LW program to ensure timely fielding of the LW system. Technologies to be pursued include lighter weight helmet materials and designs, modeling and simulation, wireless weapon and sensor interfaces, integrated sight, enhanced navigation, packet relay protocols for soldier radios, system voice control, embedded combat ID functions, helmet-mounted display upgrades, hand-held color displays, and rapid target acquisition with head orientation sensor. In addition to these technologies, integration of a miniature chemical agent detector and personnel status monitor onto the LW platform will also be accomplished for the EUT. By FY00, revolutionary upgrades to the LW system will also be performed. These technologies include electronically coupled indirect night vision, digital image processing, optimized computer architecture concepts, and interfaces to future infantry systems such as the Objective Individual Combat Weapon (OICW).

In the outyears, technologies will be pursued as technology insertions across warrior modernization initiatives. By the end of FY03, the highest payoff technologies will be validated through modeling, simulation, and virtual prototyping. Early designs for the various warrior systems will be produced using virtual prototyping techniques. All systems will be designed for maximum commonality to reduce the overall logistics burden and unit cost. The program will exploit emerging commercial technology trends to ensure that the final products—the upgraded warrior systems—are technologically superior to that of any potential adversary. The program will demonstrate the integration and supportability of technology insertions into the Land Warrior, Air Warrior, and Crew Warrior systems. Another focus of this demonstration will be the applicability of current technologies to various systems to reduce unit cost and increase producibility.

This DTO supports the following JWCOs: Military Operations in Urban Terrain, Joint Readiness and Logistics, and Joint Countermine.

Service/Agency POC	Lab/Center POC	USD(A&T)POC	Customer POC
Mr. Philip Brandler Dir., NRDEC DSN 256-4700	Mr. Pat Snow NRDEC Chief, Warrior Systems DSN 256-5436	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	COL Bosse Dismounted Battle Space Battle Lab ATSH-IWC DSN 835-2310

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603001A	DJ50	16.3	9.8	7.0	6.4	6.5	7.7	8.0
	Total	16.3	9.8	7.0	6.4	6.5	7.7	8.0

HS.11.06 ***Force XXI Training Strategies***. By FY01, this DTO will develop and demonstrate new training and evaluation technologies that prepare operators and commanders to take maximum advantage of evolving digitized C^3 systems. This training research will incorporate the use of virtual, constructive and live simulations to demonstrate and evaluate selected prototype training techniques. By FY98, the program will evaluate a prototype training package using advanced digital technologies. By FY99, the program will evaluate training and performance assessment tools developed for the digitized battlefield. Training techniques and strategies will be demonstrated and evaluated in advanced warfighting experiments. These techniques will result in a 50% improvement in training efficiency (with the number of tasks trained in the same amount of time).

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
Dr. Beverly Harris ARI, SARD-TR DSN 227-8599	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	MajGen George H. Harmeyer CG, U.S. Army Armor Center & School DSN 464-7555

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602785A	791	1.1	0	0	0	0	0	0
0602785A	790	0	1.2	1.3	1.2	0	0	0
0603007A	792	0	0	0.9	1.0	1.0	0	0
	Total	1.1	1.2	2.2	2.2	1.0	0	0

HS.12.02 ***Helmet-Mounted Sensory Ensemble.*** This DTO will develop and demonstrate advanced helmet-mounted tracker and display (HMT/D) technologies to improve mission effectiveness (50% reduction in target acquisition time), maximize lethality (3:1 increase in targets killed per pass), increase survivability (2:1 improvement in kill ratio), and enhance situational awareness (75% reduction of head-in-cockpit time), primarily for airborne systems. An ATD for a Visually Coupled Acquisition and Targeting System (VCATS) is underway to quantify the operational utility of the rapid line-of-sight cueing of missile seekers to air and ground targets as a new crew interface. The Crusader program will develop a binocular HMT/D with integral third-generation image intensifier tubes and demonstrate improvements in information management. The Helmet-Mounted Sight Plus (HMS+) will integrate a miniature color display with the VCATS helmet tracker technology and the on-board fire control system hardware, and demonstrate an exceptional advance in performance and reliability. Other critical technologies, including image source, head tracker, and helmet-vehicle interface, will be developed to improve HMT/D system performance and safety and promote commonality across airframes. Products will be transitioned to engineering and manufacturing development for the Joint Helmet-Mounted Cueing System (JHMCS) program, the F–15 System Program Office, the USN/USAF AIM–9X missile program, and the Joint Strike Fighter Program. Payoffs are an increase in mission effectiveness and tactical situational awareness, elimination of existing HMT/D operational and safety deficiencies, and full exploitation of the new generation of high off-boresight weapons. By FY97, a prototype HMT/D will be flight-demonstrated on two F–15C aircraft and evaluated by USAF Air Combat Command, showing improved weapon launch opportunities translating to improved mission success rates and transition technology to JHMCS. By FY98, the program will demonstrate binocular HMT/D with integrated image intensification. The FY00 goal is to transition upgraded technology to support JHMCS pre-planned product improvement.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
Mr. James Brinkley AL/CF DSN 785-2678	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	Maj Ron Dorn ACC/DRAW DSN 574-5914
Mr. William King ONR DSN 426-4109		Mr. Terry Witte PMA-202 (NAVAIR) 703-664-4480 x7343 (NAVAIR)
		Col Canada ATSH-IWC DSN 835-2310 (Dismounted Battlespace Battle Lab)

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602705A	AH94	0.4	0	0	0	0	0	0
0602122N		2.0	2.8	2.4	2.2	2.2	0	0
0603231F	3257	4.6	4.2	2.3	4.0	4.2	0	0
	Total	7.0	6.8	4.7	6.2	6.4	0	0

HS.13.06 ***Human-Centered Automation Testbed.*** This DTO will develop and demonstrate a field-deployable, simulation-based, human-centered automation testbed to emulate proving-ground testing during conceptual design. The purpose is to tap warfighter experience and skills in developing the best human interface with complex automated systems. Ironically, today's well-intended, state-of-the-art approaches to automation often have negative consequences for operator performance and situation awareness, partly because the crew system evaluation environment has not kept pace with the ability to automate. Engineering simulators and training simulators are separate items, yet there are large functional overlaps. This DTO strives to bring the two communities together to support all of design, evaluation, and training within a common operational context, with the warfighter's human insight and expertise as the common thread. Along with its proven utility for training, real-time warrior-in-the-loop simulation has the potential to quantify the operational utility of automation concepts as they are conceived and developed. That potential payoff has long been an advertised modeling and simulation benefit but is yet to be realized because engineering simulators have not succeeded in producing persuasive human performance data, and training simulators do not produce such data at an engineering level of detail or in time to help with system development. By FY98, the program will identify methods for estimating automation performance tradeoffs within cost and operational effectiveness analyses. By FY99, the goal is to adapt an existing test planning, analysis, and evaluation software tool for evaluating automation concepts in distributed simulation and to recommend candidate measures of performance and measures of effectiveness to be used in distributed simulation experiments, verifying their adequacy in FY99. By FY00, the goal is to complete the testbed pre-design. By FY02, the program will complete system integration and demonstrate the integrated testbed in a selected battle lab environment. An overall goal is to increase warrior participation in evaluating system requirements by a factor of 10.

Service/Agency POC	USD(A&T) POC	Customer POC	
Mr. James Brinkley AL/CF DSN 785-2678	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	LtCol C. Snead AF/XOM DSN 763-5342	Mr. Greg Powers AFMC/STX DSN 787-6561
		Col Jay Baird ACCSO-A DSN 7855291	Maj R. Painter ESC/XRPM (617) 377-3885
		Col Porter ATSH-MW DSN 464-8247	

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603231F	2830	0	1.6	2.1	2.2	2.3	0	0
0603231F	2829	0.3	0	0	0	0	0	0
	Total	0.3	1.6	2.1	2.2	2.3	0	0

HS.14.04 ***Human Performance Metrics for Theater Missile Defense.*** This DTO will develop a model of crew mental workload and situation awareness for theater missile defense (TMD). Responding to warfighter-endorsed technology deficiencies, this DTO will demonstrate practical human performance metrics for TMD, validate models and metrics against flight-test data from other TMD programs, and extend the results to other warfighting domains. The need to enhance situation awareness and reduce crew workload is a widespread justification for technology investments, but today's state of the art lacks effective human performance metrics with which to measure technology payoff. This DTO will deliver effective human performance metrics usable both for studies and analyses and for field testing.

The DTO addresses TMD because (1) lessons from Desert Storm reveal that finding and destroying mobile enemy assets was a critical shortcoming, (2) the mission comprises many fundamental tasks common to other warfighting missions, (3) human interaction is on the critical path for mission success, (4) the test community lacks measurement instruments and methods for evaluating human interactions across the entire chain of TMD crew members, and (5) metrics are central to understanding the complexities of operating complex systems, especially when multiple systems must work together in a system-of-systems, such as with TMD. Simulation of the "Scud Hunt" mission will be used to produce a model of the crew situation awareness and mental workload. Metrics will be developed based upon human performance, system performance, and physiological variables. Traditional measurement approaches will be employed in tandem with neural networks and related ways to select, combine, and weight the variables. Metrics are necessary constituents of the modeling effort and produce an additional benefit for testing and evaluation, and ultimately are the underpinning for performance aiding and adaptive systems.

By FY99, the model will be used to evaluate TMD operator situation awareness, situation displays, threat environments, and the information environments associated with TMD. Simulation studies will be conducted to evaluate the model's predictive validity. The resulting models will be applied to flight test programs such as Roving Sands/Optic Cobra. By FY02, the model-based TMD metrics will be extended to the C^4ISR domain for use in the Global Awareness Testbed. The resulting TMD model will provide the basis for refining human performance metrics both for test applications and for inclusion in an on-line operator monitoring system for adaptive systems.

Service/Agency POC	USD(A&T) POC	Customer POC	
Mr. James Brinkley AL/CF DSN 785-2678	Dr. A. Johnson-Winegar Dir., E&LS (DDR&E) DSN 227-8714	LtCol D. Blessinger 79th T&E Group DSN 872-2105	Maj R. Braun ACC/DRAO DSN 574-7067
		Maj Mark Waltensperger AFOTEC/TSE DSN 246-2237	

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602202F	7184	1.3	1.3	1.3	1.4	1.4	0	0
	Total	1.3	1.3	1.3	1.4	1.4	0	0

HS.15.06 ***Integrated Personnel Management Technologies.*** This DTO will demonstrate mathematical, statistical, and information system technologies for personnel force managers. Tools will be used to make informed, accurate planning, budgetary, policy, and execution decisions in the face of extraordinary financial, personnel, and social turbulence. By FY98, the program will demonstrate a 10% improvement in forecasting multiyear accession, promotion, and retention, preventing costly overruns in personnel appropriations while meeting skill requirements. By FY00, the program will demonstrate an intelligent job advertising and selection system that will increase the number of assignments meeting personnel preferences while increasing skill matches and reducing moving costs by over $60 million per year. The FY01 goal is to demonstrate a personnel planning system that integrates manpower requirements determination and allocation with end strength and skill inventory management and personnel distribution and assignment. The result will be improved readiness assessment, more efficient policy execution, and more effective use of limited personnel appropriation.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
Mr. C. McPeters	Dr. A. Johnson-Winegar	RADM L. Gunn
PERS-OOH	Dir., E&LS (DDR&E)	Deputy Chief of Naval Personnel
DSN 224-5632	DSN 227-8714	DSN 224-3051

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602233N		1.5	1.5	1.5	1.5	1.5	0	0
0603707N	L1170	3.0	3.0	3.2	3.2	3.3	0	0
	Total	4.5	4.5	4.7	4.7	4.8	0	0

HS.16.06 ***Interactive Multisensor Analysis Training Technology.*** This DTO will develop and demonstrate new generalizeable methods for training tactical and analytical tasks employing complex sensor systems for a range of undersea warfare applications. By FY97, the program will demonstrate a 25% reduction in training time and a 25% increase in retention of learned concepts by the complete revision of enlisted training for aviation antisubmarine warfare operators. The FY98 goals are (1) to demonstrate a 25% performance improvement in acquisition and retention of operator skills through complete revision of submarine sonar technician training, and (2) to demonstrate and evaluate a prototype advanced technology sonar employment training system that will support an FY99 OPNAV N-87 Sonar Employment Training system procurement. By FY99, the program will develop a deployable sonar operations and tactics trainer for existing and new-construction submarines requiring 50% fewer resources to develop performance-based tactical training. By FY01, the program will develop a tactical training program commencing with initial training and completing with command-level force training, integrated with common databases, at a cost 75% less than developing individual nonintegrated training systems with unique curricula, software, and hardware.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603707N	R1772	3.2	2.8	2.9	3.9	2.5	0	0
0603707N	R1773	0.9	0.9	0.9	0	0	0	0
0602233N		0.4	0.4	0.4	0	0	0	0
	Total	4.5	4.1	4.2	3.9	2.5	0	0

HS.17.05 ***Night Vision Goggle Technology.*** This DTO will demonstrate enhanced night vision goggle and sensor capabilities to improve mission safety and effectiveness during night aviation tactical operations. The coordinated AF/Navy approach is expected to result in greatly increased field of view (100 deg) with significantly enhanced sensitivity, as well as the ability to combine low-light-level-visible and infrared information into a single image. The panoramic night vision goggle (PNVG) technology will increase the intensified viewing area by 240% by taking advantage of a breakthrough optical technique combined with a newly developed, smaller format image intensifier. Unlike other night vision systems, the low-profile design of the panoramic goggle allows it to be retained safely on the warfighter's head throughout the escape sequence. This is extremely important for escape, evasion, and rescue. Additionally, the development and integration of an ultra lightweight electro-luminescent display will offer flight and navigation symbology to the pilot. During FY98, the PNVG will be demonstrated on an F–15 aircraft. Transition to the warfighter is planned in FY01. Technology advances in the color night vision sensor will develop new low-light-level, charge-coupled devices and provide real-time fusion of this visible imagery with the signals from infrared sensors. This sensor technology will be demonstrated in FY99. These technologies have applicability to a wide variety of platforms including F–15, F–16, F/A–18, A–10, AV–8B, C–130, C–17, C–141, B–52, MH–53, and MH–60 aircraft.

Service/Agency POC	USD(A&T) POC	Customer POC	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	2.5	5.0	4.9	0	0	0	0
0602202F	7184	0.8	0.8	0.8	0.8	0.7	0	0
0603231F	3257	2.1	2.0	0.5	0	0	0	0
	Total	5.4	7.8	6.2	0.8	0.7	0	0

HS.18.02 ***Precision Offset, High-Glide Aerial Delivery of Munitions, Equipment, and Personnel.*** This DTO will demonstrate revolutionary technologies for the reliable precision-guided delivery of combat-essential munitions/sensors and equipment using a high-glide wing technology and incorporating a low-cost, modular GPS guidance package and control system. This technology will provide a 6:1 or better glide ratio. By FY99, the program will demonstrate precision high glide of a 5,000-lb payload, using an advanced guidance package and high-glide wing. This technology will significantly enhance the military aerial delivery capability through substantially higher glide ratios than are possible with ram air parachutes, and will directly benefit the initial deployment of early entry forces. Technical barriers include accurate characterization of decelerator aerodynamic coefficients of performance for varied payload weights.

The program will adapt and integrate modular GPS capabilities to personnel delivery systems and demonstrate advanced airborne insertion technologies providing ultra-high-altitude insertion of individuals and small units with the ability to accurately reach drop zones from increased standoff distances during night and limited visibility conditions. These technologies will enhance the covert mobility of early entry forces in urban terrain areas and greatly improve lethality and survivability. The FY02 goal is to demonstrate a 50% increase in airborne insertion offset distance. Technical barriers include miniaturized GPS/INS airborne personnel navigation capabilities and the integration of improved high-altitude life support technologies.

This DTO supports JWCO Military Operations in Urban Terrain, Precision Force, and Joint Readiness and Logistics within the mission areas of early entry brigade airdrop, SOF airborne operations, and logistical resupply (tactical and during operations other than war). Transition opportunities for these technologies, outside of military airdrop systems, exist in the areas of submunitions dispensers, unmanned aerial vehicles, aircraft decelerators, aircraft antispin devices, and interplanetary recovery systems.

Service/Agency POC	**Lab/Center POC**	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603001A	D242	1.3	1.3	1.3	1.9	3.2	3.5	3.7
	Total	1.3	1.3	1.3	1.9	3.2	3.5	3.7

HS.19.05 ***Rotorcraft Pilot's Associate.*** By FY99, the Rotorcraft Pilot's Associate (RPA) program will develop and demonstrate, through simulation and flight test, a knowledge-based associate system for real-time cognitive decision aiding. The RPA ATD will apply artificial intelligence and advanced computing technologies to create a cooperative man–machine system which understands and uses information from onboard and offboard sensors, teammates, and organic mission equipment to develop plans to facilitate the achievement of mission objectives. RPA will provide high-speed data fusion processing, automated continuous mission planning, context-sensitive reconfiguration of mission equipment controls, efficient and intuitive cockpit information management, crew intent estimation, and greatly improved situation awareness. In addition, RPA will serve as the mission equipment integrator for the aircrews and will collect, synthesize, and disseminate pertinent battlefield information. Measures of performance beyond a "Comanche-Like" baseline during day/night, clear/adverse weather on the battlefield include reduction in mission losses by 30–60%, increased targets destroyed by 50–150%, and a reduction in mission time lines by 20–30%.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603003A	DB97	0.5	0.4	0.2	0	0	0	0
0603003A	D436	24.6	17.4	5.1	0	0	0	0
	Total	25.1	17.8	5.3	0	0	0	0

HS.20.06 ***Warfighter System Modeling.*** This DTO will develop a robust simulated environment to support analytical capabilities and promote rigorous individual combatant trade analyses to quantify and evaluate alternative system concepts, equipment, and operational policy. It will accomplish this by supporting the virtual prototyping, evaluation, and effectiveness assessment of proposed combatant system concepts and equipment, thus increasing the number of alternatives that can undergo exhaustive scrutiny prior to construction of prototypes. Warfighter System Modeling will combine numerous engineering-level models, such as individual casualty (ballistic, chemical, blunt trauma, etc.), protective materiel performance, individual target detection/recognition, human physiological performance, and individual suppression, with supporting data into a single warfighter simulation. It will assess and quantify performance of dismounted combatant systems such as Force XXI Land Warrior (FXXILW) under battlefield conditions that would not otherwise be possible during peacetime testing due to risk, cost, or prohibition of law. These assessments will provide the defendable data input required by training simulators, avoiding the historically expensive requirement to conduct extensive destructive live fire and field testing. The automated environment will provide the means to reduce the cost and time associated with the design, testing, and fielding of individual combatant systems by at least 25%.

By FY98, the program will provide modeling, simulation, and analytic tools facilitating the design and cost and operational effectiveness analysis (COEA) of the Land Warrior Program. Deliverables will include detailed real-time, engineering-level models of wound ballistics and blunt trauma. Additional research efforts will provide improved methodologies in enhanced anatomical databases, bullet and flechette penetration submodels, body armor failure submodel, and a fully articulated anatomical model. By FY99, the program will employ a distributed interactive simulation-compliant methodology to assess warfighter system demonstrations and provide a basis for future COEAs.

This DTO supports JWCO Military Operations in Urban Terrain, Combat Identification, Joint Readiness and Logistics, Counter Weapons of Mass Destruction, Chemical/Biological Warfare Defense and Protection, and Joint Countermine. These efforts will benefit emerging as well as fielded systems, including FXXILW, Air and Land Warrior, Combined Arms Tactical Trainer (CCTT), Modular Body Armor, Body Armor Set Individual Countermine, Joint Service Lightweight Integrated Suite Technology II, Objective Individual Combat Weapon, HLA Computer-Generated Forces, and Objective Crew-Served Weapon.

Service/Agency POC	**Lab/Center POC**	**USD(A&T) POC**	**Customer POC**
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602786A	AH98	1.5	1.5	0.9	0	0	0	0
0602618A	AH80	0.3	0	0	0	0	0	0
	Total	1.8	1.5	0.9	0	0	0	0

HS.21.06 ***Weapon System Decision Support.*** This DTO will provide performance-enhancing decision support technology and systems for intelligent cockpits, command posts, and shipboard command centers. The technology goals are to demonstrate maintainable decision aids that minimize cost and enhance mission effectiveness and survivability of global forces. For combat aircraft, projected benefits include lowering aircraft weight by 5,000 lb when compared to the F–15E mission performed by the single-seat fighter. This technology will significantly improve command decision-making by enhancing situation assessment and option generation, and by reducing ambiguity in operating and directing land, sea, and air forces, while enabling the warfighter to act as battle manager relieved of lower details of system operation. The program will transition decision support systems that operate fast enough to make a difference to battle management and combat success. By FY97, the goal is to transition missile trajectory and target prediction algorithms to Talon Lance, demonstrate dynamic cockpit function allocation, and provide a software verification and validation tool with commercial potential. By FY98, the program will test a cockpit decision aid capable of detecting and correcting hazardous errors, demonstrate an aid for real-time inflight route optimization, and recommend an aid for air target prioritization. The FY99 goal is to demonstrate a decision support system for shipboard command centers and combat operations centers that operates in real time and improves situation assessment by 40%. By FY00, the program will transition a full-mission route planning and optimization aid, test a life-cycle support aid, flight test a knowledge-based target assignment algorithm, and demonstrate collaborative joint commander. The FY01 goal is to verify a 50% gain in target kills achievable through combat aircraft decision support.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602233N		6.2	5.6	5.8	6.0	6.1	0	0
0603707N	R1771	2.1	2.1	2.2	2.2	2.3	0	0
0602201F	2403	0.2	0.3	0.4	0.4	0.4	0	0
	Total	8.5	8.0	8.4	8.6	8.8	0	0

WEAPONS

WEAPONS

WE.02.07 ***Land Mines.*** This DTO will develop and demonstrate an affordable, rapidly deployable land mine system for early entry operations with 50% greater kill probability against armor vehicles. To achieve this objective, the Intelligence Minefield (IMF) ATD will internet wide area munitions (WAMs) and advanced acoustic sensors into an autonomous antiarmor/antivehicle system by demonstrating communication, command, and control; sensor fusion of acoustic sensor data; autonomous implementation of engagement tactics; advanced acoustic sensors; and exportable combat and target information. In FY97, the IMF ATD will demonstrate (through field test and simulation/modeling) an integrated IMF system that will internet WAMs and advanced acoustic sensors to increase WAM minefield effectiveness. The advanced acoustic sensors will have a detection range of 2–3 km and a tracking capability of up to seven target vehicles. Also demonstrated will be a control station that will communicate, command, and control two minefields consisting of 20–40 WAMs while maintaining an interface to the maneuver command system. The RFPI ACTD field exercise will take place in FY98.

Metrics include a 50–100% improvement in overall minefield performance; a 2–3-km minimum range acoustic detection; a 7+ target tracking; and a robustness criteria for ACTD residuals. Technical barriers include target association and classification, target location accuracy, and real-time target information processing.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603004A	DL95	2.2	0	0	0	0	0	0
	Total	2.2	0	0	0	0	0	0

WE.04.04 ***Airborne Lasers for Theater Missile Defense.*** This DTO will develop and demonstrate technology for development of an operational high-energy airborne laser (ABL) for theater missile defense (TMD). It will address risk reduction issues for development of the ABL demonstrator and the subsequent development of an ABL system with full operational capability. Key technical challenges include development of laser device technology to meet the weight and volume constraints of the aircraft platform, and development of adaptive optics and beam control technology to substantially compensate for optical distortions and beam jitter introduced in the ABL propagation scenario. To address these challenges, this technology program investigates and demonstrates atmospheric propagation over long horizontal paths with significant turbulence using advanced tracking and atmospheric compensation technology, and works to reduce the weight of chemical oxygen-iodine laser devices for installation on aircraft which can meet TMD mission requirements. Specific demonstrations include active tracking field tests against boosting missiles, and ground testing integrated atmospheric compensation and tracking, scaled to replicate the propagation conditions expected in a theater missile engagement scenario. ABL technology objectives are to increase the atmospheric compensation and beam jitter strehl ratios (ratio of the beam intensity achieved compared to the ideal) by a factor of 2 and to increase the laser device efficiency by 10–20%. ABL tracking, adaptive optics and laser device technologies pay off in performance growth and additional margin in the operational capability of the ABL weapon system. The Air Force separately funds the ABL system program office for demonstrator design and development to meet a FY02 subscale system demonstration. The ABL technology program will meet classified laser and optics performance milestones in FY97 for the ABL contractor down-select decision, in FY98 for demonstrator PDR, and in FY99 for demonstrator CDR.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603605F	3647	10.7	12.3	10.1	9.8	9.0	9.1	9.4
	Total	10.7	12.3	10.1	9.8	9.0	9.1	9.4

WE.07.02 ***Future Missile Technology Integration Program.*** This DTO will demonstrate a technology to build a multiplatform, multitarget/multimission extended-range (beyond 7 km) fire-and-forget missile that is size compatible with the TOW and Hellfire family of launchers. Lock-on-after-launch technology will be developed capable of locking onto both ground and airborne targets in clutter at 5 km. In addition, lock-on-after-launch (beyond 5 km) technology will be developed allowing engagement of ground and airborne targets beyond visual range at ranges up to 10 km.

Aspects of the technology demonstration phase of the Future Missile Technology Integration (FMTI) Program include captive flight testing of missile components (including seeker, RF datalink, autotracker, and automatic target recognition); and static firings of gel rocket motor, hardware-in-the-loop, digital simulation of all missile components, and development of a distributed interactive simulation of a virtual prototype of FMTI missile capability on the future battlefield. In addition, the FMTI technical demonstration phase will demonstrate in FY98, through three live missile firings, lock-on-before-launch fire-and-forget guidance against an armored vehicle at ranges up to 5 km.

Milestones include, by the end of FY97, demonstration of all missile flight components to include an imaging infrared seeker and a gel bipropellant rocket motor.

Technical barriers include the ability to lock onto ground vehicles in clutter at long range (up to 5 km), efficient packaging of all missile components in a TOW-size missile volume, and developing the capability to control gel motor delivered thrust during long-range flyout.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603313A	D263	9.0	1.0	0	0	0	0	0
	Total	9.0	1.0	0	0	0	0	0

WE.10.08 ***Ground-Based Laser Antisatellite Technology.*** This DTO will develop and demonstrate ground-based laser (GBL) technology to support a system development decision for a GBL antisatellite (ASAT) system. A central part of the effort is the Air Force Integrated Beam Control Demonstration ATD, with parallel efforts in technology development for the chemical oxygen-iodine laser (COIL) device, high-power optical components, and satellite vulnerability assessments. The ATD uses the 3.5-m telescope at Starfire Optical Range and will demonstrate, at full scale but low power, weapons-class performance for all beam control functions associated with an end-to-end satellite engagement. These major functions include initial optical acquisition of the target satellite and coarse tracking using passive sensors, flood illumination of the satellite with a moderate power illuminator laser, handoff to precision active tracking, atmospheric compensation using adaptive optics and laser beacon sensing, designation of the desired aimpoint on the satellite target, laser beam propagation to hit the selected aimpoint, and aimpoint maintenance for the required engagement time. The principal technology issues are (1) the demonstration of COIL technologies for thermal control and fluid recycling, to meet requirements for long run-time and re-fire times between laser shots; (2) the development of scaled adaptive optics, laser beacon concepts/hardware, and control systems to meet atmospheric compensation performance goals for full-scale (3.5–4 m) apertures, using laser beacon sensing of distortions due to atmospheric turbulence; (3) the development of laser illuminators and track sensors/processors to meet requirements for 24-hour active tracking of satellites to the required precision; and (4) the development of aimpoint designation and maintenance techniques to meet requirements for laser beam pointing.

Primary metrics for this demonstration will be atmospheric compensation performance, residual satellite tracking error, and laser beam pointing accuracy for aimpoint stabilization. Specific performance goals are classified, but they generally involve an improvement by factors of two to four over currently demonstrated capabilities at the subsystem level, as well as the simultaneous demonstration of improved performance for all subsystems in integrated testing. A series of increasingly complex integrated beam control field tests will culminate in the final ATD demonstration in FY01. Intermediate ATD results include initial active tracking of LEO satellites (FY97), installing full-scale adaptive optics on 3.5-m telescope (FY98), and integrated beam control tests against lower (400 km) LEO satellites in nighttime testing (FY99). The final ATD demonstration in FY01 will be conducted against higher (up to 1,200 km) LEO satellites during night and day. Low-power integrated beam control results will be extrapolated to high power through detailed simulation and performance analysis.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603605F	3647	13.1	13.4	12.4	10.6	11.1	11.3	11.6
	Total	13.1	13.4	12.4	10.6	11.1	11.3	11.6

WE.12.02 ***Antijam GPS Flight Test.*** This DTO will develop and demonstrate a Global Positioning System (GPS) antijam (AJ) technology to increase the accuracy provided by any munition GPS/IMU navigation system maintained in a jamming environment. GPS signals arrive at a very low power level. Interference as low as 10 W can jam GPS as far away as 100 nmi. Inertial measurement unit (IMU) navigation is immune to GPS jamming energy. However, IMUs drift with time causing a munition's accuracy to degrade. Higher quality IMUs can improve endgame accuracy, but are more expensive.

The objective of this effort is to provide the best AJ capability for the lowest possible increment (less than $3,000) to the Joint Direct Attack Munition (JDAM) unit production cost (based on a 72,000-unit buy in FY92 dollars). Success will be measured by maintaining JDAM-required GPS navigation accuracy at the target (13-m CEP) while in a jammed environment. Additionally, the program will develop a cost/performance modeling tool that will enable a user to determine the cost per jam resistance needed for his particular application.

During Phase I, the AJ concept was tested at the subsystem level against scenarios containing multiple jammers to demonstrate AJ performance capability. Phase I subsystem tests were conducted in anechoic-chamber (Naval Research and Development, Warminster, PA) and bench-test (Antenna Wavefront Simulator, Wright Laboratory Avionics Directorate) environments. Phase II of the program (Jan 96–Feb 97) integrates the AJ concept into a suitable carrier vehicle (a JDAM Tail Kit Assembly) for ground and flight tests in a jamming environment. Phase III (Mar 97–Aug 97) involves ground tests of the fully integrated Tail Kit Assembly in a static and semi-dynamic environment. The Tail Kit Assembly will be evaluated in the anechoic chamber at Eglin AFB to obtain antenna performance data of the actual flight hardware, which will be used to update the cost/performance model. The second ground test will use the Wright Laboratory Armament Directorate's Mobile Test Vehicle to introduce the AJ-equipped JDAM navigation system to a low dynamic jammed environment for risk reduction prior to flight testing. Phase IV (Sep 97–Feb 98) is the flight test portion of the program. The test will use a GPS-equipped F–16 to release the AJ-equipped munition in two jamming environments of increasing difficulty.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603601F	670A	2.6	3.1	0	0	0	0	0
Total		2.6	3.1	0	0	0	0	0

WE.13.02 ***Counteractive Protection System.*** The goal of this DTO is to develop and demonstrate techniques and technologies to allow antitank guided weapons (ATGWs) to defeat threat tanks equipped with active protection systems (APSs). Technology components of the Counteractive Protection System (CAPS) suite include radar countermeasures, advanced long standoff warheads, and missile armoring techniques. These techniques work together or separately to defeat threat APS by preventing the detection, tracking, or destruction of an ATGW before it can successfully defeat the target. RF countermeasures must limit probability of detection to 10% at the minimum response range of the APS munition system. Long standoff warheads must perforate target armor at the maximum range of the APS munition for 90% of possible engagements.

Specific technology advancements are expected in the areas of RF transmitters, antennas, long standoff shaped-charge warheads, advanced materials for missile armor, and impact sensors for characterizing high-velocity impact phenomena.

CAPS mid-term RF countermeasures will be demonstrated in a breadboard form by FY98, and in flight prototype (FY99 and FY00). Far-term RF countermeasures will be breadboarded by FY99 and demonstrated in flight prototype by FY01 and FY02. A near-term RF countermeasure is currently being transitioned to a flight demonstration sponsored by a missile system project manager. Long standoff warheads will be demonstrated statically in FY98 and dynamically in FY99. A long standoff warhead integrated with munition survivability technology will be demonstrated in a dynamic sled test in FY99 and in an integrated flight demonstration against an APS target in FY01.

The payoff for successful development and demonstration of CAPS technologies will be to limit the reduction of ATGW lethality to less than 10% against modern tanks using APS.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603313A	D550	1.9	1.9	4.4	5.5	4.0	4.0	0
0602303A	A214	0.4	0	0	0	0	0	0
0602618A	AH80	0.3	0.3	0	0	0	0	0
0602618A	AH81	0.5	1.5	0	0	0	0	0
0603004A	D232	0.5	0.5	2.9	0	0	0	0
	Total	3.6	4.2	7.3	5.5	4.0	4.0	0

WE.17.02 ***Hammerhead***. This DTO will demonstrate, by FY97, a synthetic aperture radar (SAR) seeker which physically, electrically, and logically will integrate with a GBU–15 weapon to perform autonomous, precision guidance. The objective is to demonstrate, by FY99, a SAR-guided weapon with a capability against fixed targets obscured by cloudy or foggy conditions and over 10 nmi/hr of rain, a significant increase over existing laser-designated munitions, and which strikes the target within 3 m or less, a threefold improvement over GPS/INS guidance systems. This demonstration will include the ability to attack targets with an angle of impact of 60 degrees or greater from the horizontal ground plane and an angle of attack of 5 degrees or less between the bomb velocity vector and the bomb roll axis. All seeker imaging, guidance, and other data will be recorded via an AMRAAM telemetry unit. Adverse weather will not preclude demonstrations except when the required optical scoring systems are significantly affected. Captive flight missions will be conducted in adverse weather to assess the effects on seeker operation. Mission planning will be accomplished by a trained operator in 15 minutes or less, a significant improvement over current autonomous mission planning timeliness which can take days. SAR seeker technology demonstrated under this program will allow operational commanders much greater flexibility in weapon employment since an enemy will not be able to hide in adverse weather conditions, whether natural or manmade. Response to time-critical targets can be immediate. The precision guidance capability greatly reduces collateral damage to targets in heavily populated civilian areas and increases weapon lethality, thus requiring fewer aircraft sorties, reducing aircraft attrition. The autonomous capability improves shooter aircraft survivability through an increase in standoff range limited only by weapon kinematics, increases the aircraft's weapon capacity through the elimination of targeting or datalink pods, and allows carriage on single seat aircraft by eliminating man-in-the-loop requirements.

Producibility enhancements under consideration have the potential to reduce seeker costs from $150,000 to less than $30,000 per unit, significantly improving weapon affordability. This effort will provide a revolutionary new air-to-surface precision guidance capability for operations in adverse weather.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603601F	670B	5.1	3.0	2.6	0	0	0	0
	Total	5.1	3.0	2.6	0	0	0	0

WE.18.02 ***Direct Fire Lethality.*** This DTO focuses on enhancing the hit-and-kill capabilities of the Abrams tank. The DTO consists of three major elements: an Advanced Kinetic Energy (KE) Cartridge (for defeat of explosive reactive armor (ERA) and increased accuracy); Smart Target Activated Fire and Forget (STAFF) enhancement (increasing warhead effectiveness against ERA); and advanced drives and weapon stabilization (increasing probability of hit under moving conditions).

FY96 goals include component development, with FY97 demonstration of 120mm KE precursor penetrator to defeat the 2005 ERA projected threat with a 50% increase in lethality over the M829A2. In FY98, the goal is to statically demonstrate a 120mm STAFF dual-liner explosively formed penetrator (EFP) warhead function to form an ultra long EFP and conduct a hardstand dynamic demonstration of an Electric Direct (gearless) Turret Azimuth Drive technology. In FY99, a Smart Barrel Actuator active damping control of a M256 120mm gun tube will be demonstrated in a nonfiring, dynamic test resulting in FY00–01 demonstrations of same. The ATD exit criteria in FY00 require an integrated 120mm KE Cartridge to defeat the 2005 ERA protected threat, with a 30% increase in system accuracy under stationary conditions over the M829A2/M1A2, and the demonstration of a 33% or more increase in armor defeat with a 120mm dual-liner STAFF warhead. In FY01, demonstrate a 300% increase (at 3 km) in probability of hit over the M1A2 under dynamic scenarios using Smart Barrel Actuators, fully integrated gearless turret/gun direct drives, and modern digital servo control. (Note: The Advanced KE Cartridge Fast Track Acquisition Program is a joint effort with PM-TMAS. The PM will provide $4.6 million in FY98 and $6.8 million in FY99, pending an M829E3 technology decision in FY97.)

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602624A	AH18	1.1	1.5	0.7	0	0	0	0
0602624A	AH19	0.7	0	0	0	0	0	0
0602618A	AH80	0.3	0.3	0	0	0	0	0
0602618A	AH81	2.2	0.5	0	0	0	0	0
0603004A	D232	3.8	7.2	4.8	3.6	0	0	0
0603004A	D43A	0	0	7.1	6.2	4.0	0	0
	Total	8.1	9.5	12.6	9.8	4.0	0	0

WE.19.08 ***HPM Aircraft Self-Protect Missile Countermeasures.*** The goal is to develop and demonstrate ultra wideband (UWB) high-power microwave (HPM) technology to provide robust protection of large aircraft against the rapidly proliferating infrared, EO, RF and laser-guided missile threat. Ongoing missile susceptibility tests are defining the most effective and efficient kill mechanisms: disruption of seeker, guidance, or fuze electronics. Modeling and simulation tools are nearly complete and will be used to support/enhance RF effects tests and to analyze engagement scenarios. As of September 1996, the source technology selected for this effort is an array of individual laser-triggered solid-state sources which produces a narrow, electronically steerable beam. An UWB HPM brassboard (consisting of source, antenna, and power conditioners) will be developed in FY97 and built in early FY98. The brassboard will be packaged for a field demonstration in the fourth quarter of FY98 in conjunction with the DoD infrared countermeasures program. A significant parallel effort explores the EMI/EMC issues relating to the host aircraft. Aircraft hardening and HPM antenna backlobe and sidelobe suppression methods are being developed and demonstrated. HPM is a nonexpendable, generic countermeasure capable of defeating a large variety of missiles without a priori knowledge of specific threat parameters.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	5797	1.4	1.3	0	0	0	0	0
0603605F	3152	1.8	1.6	0.2	0	0	0	0
	Total	3.2	2.9	0.2	0	0	0	0

WE.21.02 ***Fiber Optic Gyro-Based Navigation Systems.*** The Global Guidance Package (GGP) tightly integrates a miniature GPS receiver and an all-solid-state, low-cost, navigation-grade, interferometric fiber-optic gyroscope (IFOG)-based miniature inertial measurement unit (MIMU) with an advanced navigation computer into a low-cost ($15,000) precision navigation system. The thrusts within the GGP also will increase the robustness of GPS receivers by increasing their ability to operate effectively in presence of enemy jamming or countermeasures. The all-in-view miniature GPS receiver (MGR) chipset will be upgraded to demonstrate direct P (Y) code acquisition by employing a fast-acquisition correlator engine and high-performance clock. Operation with P (Y) code signals increases the MGRs robustness to jamming. The program will provide for the design, development, implementation, and demonstration of a low-cost, all digitally controlled, GPS adaptive phased array receiver antenna. Coherent array beam forming and signal processing will be performed with digital circuits, eliminating costly, precision-matched analog antenna components and antenna recalibration for stressing military environments. These technologies also increase MGR robustness to jamming. Finally, the GGP program will develop and demonstrate a low-power, long-endurance MGR. This will increase MGR battery endurance, and thus availability of accurate navigation, from hours to days for dismounted troops.

An alternate approach for a miniaturized IMU being pursued by the Navy, the Precision Strike Navigator, will be demonstrated by FY98. Using advanced polymer-on-silicon technology, a low cost ($2,000/axis), 1-nmi/hr (inertial grade), hybrid fiber optic gyro (FOG)-based inertial measurement unit (IMU) chip, containing the accelerometer, FOG optics, and all of the IMU electronics, will be demonstrated. The fiber coil is external to the chip. It provides a potential low-cost miniature inertial grade IMU whose projected cost is $6,000 (based on 100,000-unit production volume) for a complete three-axis IMU. This IMU could then be integrated with a miniaturized GPS receiver.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603762E	SGT–01	10.3	19.2	15.6	11.8	10.0	0	0
0603217N	R2264	3.3	2.0	4.3	3.1	2.5	0	0
Total		13.6	21.2	19.9	14.9	12.5	0	0

WE.22.09 ***High-Power Microwave C^2W/IW Technology.*** This DTO develops and demonstrates high-power microwave (HPM) technology to disrupt, degrade, and destroy electronics in communication and information systems to support command and control/information warfare (C^2W/IW) and suppression of enemy air defense (SEAD) missions. Adversaries will be denied use of electronic information processing and communications systems by using high-peak (damage) and high-average (disruption) power wideband sources packaged for an air-deliverable bomb, submunition, man-portable device, or unmanned aerial vehicle (UAV). Nonlethal or lethal technology will initially concentrate on man-portable (short-range) or heavy transportable weapons and SEAD applications, followed by airborne weapons on UAVs or as submunitions, as prioritized by user needs and technical maturity.

Ongoing susceptibility/effects testing on information processing and communications systems of military interest will define specific HPM source and antenna requirements by FY99. In FY00, the first brassboard system will be used in a critical experiment to demonstrate feasibility to the user. With user-defined metrics and measures of effectiveness, the first-generation ATD will be conducted in FY01.

This effort exploits generic HPM effects on information and communications systems without a priori knowledge of specific target parameters. Specific details are classified and can be provided to appropriate agencies upon request.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	5797	2.2	2.1	3.5	3.6	3.7	3.8	3.9
0603605F	3152	4.4	5.4	6.5	6.0	6.9	7.1	7.3
0602715H	AC	1.2	1.1	0	0	0	0	0
	Total	7.8	8.6	10.0	9.6	10.6	10.9	11.2

WE.23.08 ***Modern Network Command and Control Warfare Technology.*** The objective is to develop and demonstrate multiple synergistic capabilities to intercept and attack or counter advanced, global, military communication/navigation/information networks from ground and airborne platforms. In FY98, the program will demonstrate unmanned aerial vehicle (UAV)-based electronic support (ES) and real-time relay to ground and air components of the Intelligence EW Common Sensor (IEWCS) System. By FY00, the program also will demonstrate ES and EA strategies to counter emerging modern complex communication formats, conduct a joint test with WE.46 for evaluation of SEAD, and demonstrate a tenfold increase in HF wideband power generation in a comparable package volume. The FY01 goal is to demonstrate non-fratricidal electronic attack (EA) techniques versus communication/navigation systems. By FY02, it will demonstrate ES/EA capability against a low-probability-of-intercept/-detection (LPI/LPD) class of specific communications links characterized by featureless, time-division, and code-division multiplexing formats. By FY02, the program will also provide the capability to selectively influence an adversary's use of or confidence in information, processes, systems, and computer-based networks through the use of offensive deceptive techniques to manipulate the information or information sources which support them.

By FY03, the program will show a 1,000 times improvement in effective use of available transmitter power, and a 1,000 times improvement in EA spatial selectivity for jamming strategies. Achievement of this DTO will enable joint forces to wage proactive, offensive information warfare against an enemy's command and control information infrastructure and delay/deny effective enemy defense versus U.S./coalition strike forces.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602270A	A906	2.5	2.5	2.9	4.0	4.0	4.0	4.0
0603270A	DK15	3.2	2.9	5.4	1.9	1.2	3.2	3.0
0602270N		0.7	0.7	0.7	0.8	0.8	1.0	1.0
0602204F	2000	0.2	0.2	0.2	0.3	0.1	0	0
0603270F	2432	0	1.5	4.1	5.2	5.5	4.0	0
0603270F	2754	1.0	0	0	0	0	0	0
	Total	7.6	7.8	13.3	12.2	11.6	12.2	8.0

WE.25.02 ***Multimode Airframe Technology Demonstration.*** By FY98, this DTO will demonstrate—through modeling, simulation, and flight testing—a 40-km-range, day/night system that is compatible with the MLRS family of missiles (MFOM) and that is capable of striking multiple, high-value, time-sensitive point targets while inflicting minimal collateral damage. The Multimode Airframe Technology (MAT) system will provide the capability to select priority targets after launch, conduct limited man-in-the-loop BDA, and provide target area reconnaissance in addition to target attack by means of variable cruise velocity over areas of interest. These capabilities will be achieved by means of integrated GPS and inertial navigation, variable threat air-breathing propulsion, composite material airframe providing low IR signature and low RCS, variable geometry wings, imaging IR seeker, and other appropriate technologies. The MAT system will provide an integrated airframe/turbojet with a velocity capability of 300 m/s and payload capability of at least 20 lb.

Milestones include, by FY97, integrating and testing the flight computer/autopilot software, integrating and testing flight hardware, and performing a full-up missile sled test; and, by FY98, 40-km flight tests. Technology barriers include 40-km fiber payout in missile-sized canister; low-cost turbojet technology for both boost and sustain; and reconfigurable airframe for slow and fast flight.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602303A	A214	3.4	3.2	2.0	0	0	0	0
	Total	3.4	3.2	2.0	0	0	0	0

WE.27.02 ***Concurrently Engineered Ball-Joint Gimbal Imagery Seeker.*** This DTO will demonstrate, by FY99, via captive-carry flight testing, an integrated set of high-risk seeker subsystem technologies and concepts designed to reduce the throw-away cost of strike weapon systems by 35–50%. Specifically, this effort will focus on developing and demonstrating a innovative ball-joint gimbal concept; integrating and demonstrating an affordable industry-standard, large field-of-view staring infrared focal plane array (IRFPA) with the ball-joint gimbal by leveraging advanced technology developed under the DARPA IRFPA Flexible Manufacturing Program and applying design for manufacturability and assembly processes coupled with engineering computer automated design systems. The estimated resource savings from this program is $35,000 to $55,000 reduction in the unit cost of an IR strike seeker. This cost savings is based on a $110,000 estimated cost for a current IR seeker. Based on future JSOW and Tomahawk inventory objectives, the potential exists to save over $400 million using the technologies demonstrated under this ATD.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603217N	R0447	3.7	4.9	4.2	0	0	0	0
	Total	3.7	4.9	4.2	0	0	0	0

WE.29.02 ***Antitorpedo Torpedo ATD.*** The goal is to demonstrate, by FY99, Antitorpedo Torpedo (ATT) homing and fuzing which can be incorporated into existing and planned torpedo and Submarine Regional Warfare Systems. The effort is to embed ATT homing and fuzing technology developed in the 6.2 program in a prototype guidance system and demonstrate performance against torpedo targets in clean, CM, salvo, ship-wake, and shallow-water environments. The technologies to be demonstrated include high-range-resolution, high-repetition waveforms; high-pulse-rate signal and image processing; adaptive CM processing; integrated homing and fuzing; acoustic intercept receiver; data fusion; and torpedo defense specific tactics. Success of the DTO will be measured against the closest points of approach (CPAs) required to destroy ASW and ASUW threat torpedoes. Demonstration of these CPAs will include operation against threat torpedoes in realistic surface ship and submarine battle environments. Surface ships and submarines need a hardkill torpedo defense capability to ensure their survivability in future conflicts. Fewer ships will be operating in littoral waters and will encounter an emerging threat posed by the proliferation of quiet, capable, diesel-electric submarines armed with modern, lethal weapons. Moreover, many of these encounters will be close-in and will demand quick reaction. This ATD will develop and demonstrate a new hardkill torpedo defense homing and fuzing technology based on common hardware and software compatible with existing and future U.S. torpedo systems (i.e., 21", 12.75", and 6.25" diameters). These technologies will be inserted (with minimal impact) into existing operational torpedo inventories, and their stockpile-to-target systems, to quickly provide significant and cost-effective warfighting capabilities.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	4.0	5.0	5.0	0	0	0	0
0602633N		2.0	0	0	0	0	0	0
	Total	6.0	5.0	5.0	0	0	0	0

WE.32.02 ***Broadband Torpedo Sonar Demonstration.*** This DTO will demonstrate, by FY01, broadband sensors, sonars, and signal processing which can be incorporated into existing and planned torpedo systems. Undersea weapon performance must be improved in harsh shallow-water acoustic conditions with highly reverberant environment aggravated by high sea states, single- and multiple-boundary scattering, false targets, and false alarms (biologic, geologic, and boundary features). In addition, the problem is compounded by low-signature diesel/electric submarines which may be bottomed, surfaced, or proceeding at very slow speeds. Target alert caused by weapon search gives the target opportunities to hide in the environment, deploy CMs, or evade. Broadband G&C techniques are expected to provide major improvements in shallow-water target detection, CM resistance, target resolution, and multiscale imaging for false target classification, and are applicable to coherent intersensor processing leading to interoperability. In addition, covert, undetectable weapon search techniques could significantly increase weapon effectiveness in this difficult environment. The approach will include broadband sensors and signal processing, including the use of wavelet signal processing. Emphasis will be placed on broadband G&C and on covert search techniques.

The goal is to demonstrate bandwidth five times that of existing torpedo sonars. Broadband sensors and signal processing technologies will be developed in the 6.2 program and demonstrated in water in an ATD planned for FY99. The ATD will integrate broadband sensors and signal processing techniques into a test vehicle and demonstrate improved performance in shallow-water environments against both artificial and real targets. The demonstrations will show detection ranges increased by a factor of two and false alarm probabilities reduced by a factor of two, relative to existing narrow-band systems. These demonstrations will be concluded in FY01. The sensors and signal processing demonstrated will be capable of being inserted with minimal impact into existing operational torpedo inventories and into any new torpedo developments, and will provide significant, cost-effective enhancements to warfighting capabilities.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602633N		2.3	3.4	3.7	3.8	3.8	0	0
0603792N	R1889	0	0	4.0	4.5	5.0	0	0
0603747N	R2267	0	1.5	1.5	1.5	1.5	1.5	0
	Total	2.3	4.9	9.2	9.8	10.3	1.5	0

WE.33.02 ***ETC and EM Armaments for Direct Fire.*** This DTO will demonstrate the technical feasibility of electrothermal-chemical (ETC) propulsion for near-term (FY05–FY10) and electromagnetic (EM) launch for far-term (FY15–FY20) integration into direct fire weapon systems. ETC will provide current 140mm lethality for projectiles fired from a 120mm XM291 cannon. EM will provide a highly robust lethal capability against postulated advanced threat defensive systems with the additional benefits of improved survivability and reduced logistic needs.

Specific demonstrated capabilities of ETC include, by FY99, 17-MJ muzzle energy from an 120mm XM291 cannon. Specific demonstrated capabilities in EM and ETC include, by FY99, pulsed power systems compact enough for armored vehicles, specifically compensated pulsed alternators capable of 3.0 J/g. Specific demonstrated capabilities in EM include, by FY99, hypervelocity launchers with a 100-round tube life and integrated launch packages with less than 50% parasitic mass launched at 2.5 km/s having a muzzle energy of 7 MJ. For all classes of electric armaments, systems analysis and critical tests show improved battlefield effectiveness and no fatal flaws.

Milestones for ETC include, in FY97, two possible propulsion candidates which can be fired from a 120mm cannon and, in FY98, demonstration of 14-MJ muzzle energy fired from an 120mm M256 cannon. Milestones for CPA include, in FY97, 1.5 J/g specific energy in a pulsed power system. Milestones for EM include, in FY97, a demonstration of a wear-resistant rail material; by FY98, that there are no EM specific accuracy barriers; and, by FY97, that parasitic mass in subscale projectiles is reduced.

Technical barriers for ETC include high-energy, high-density propellant formulations and geometries; design of plasma capillaries for effective coupling of electrical energy into propellants; and control of propellant temperature gradient effects. Those for EM are high-strength, thick-section composites; high-current capacity, fast-actuating and -recovering solid-state switches; high-efficiency launchers; thermal management; and reduced mass armatures.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602618A	AH75	5.4	6.4	6.9	0	0	0	0
0602715H	AC	3.0	3.0	0	0	0	0	0
	Total	8.4	9.4	6.9	0	0	0	0

WE.34.02 ***Objective Crew-Served Weapon Technology Demonstration.*** The OCSW will demonstrate by FY00 a highly lethal, suppressive, and deployable crew-served weapon system. The OCSW system will provide decisively violent and suppressive target effects, including a high probability of incapacitation against protected personnel (body armor and in defilade) out to 2,000 m and a high potential to damage light and lightly armored vehicles beyond 1,000 m. The OCSW will exploit lightweight, high-strength materials; modular optoelectronic full solution fire control (leveraged from the OICW ATD program); electronic time-set fuzing; and high-explosive air-bursting munitions. The OCSW will be a lightweight, two-man portable, single replacement weapon system for the current 40 mm MK19 Grenade Machine Gun and the Caliber .50 M2 Heavy Machine Gun.

Specific capabilities to be demonstrated include a weapon system with component weight goals as follows: weapon less than 38 lb, a ground mount less than 12 lb, ammunition less than 0.35 lb, and a fire control less than 7 lb. The system will have the capability to defeat defilade targets and 51mm rolled homogeneous armor.

Technical challenges for the OCSW include efficient fragmentation, electronics miniaturization (fire control and fuze), systems integration, and overall system weight.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602623A	AH21	0.7	0	0	0	0	0	0
0603607A	D627	3.2	1.4	2.1	3.0	0	0	0
	Total	3.9	1.4	2.1	3.0	0	0	0

WE.35.02 ***Air Superiority Missile Technology.*** This DTO will demonstrate, through design, ground test, and flight test efforts, missile flight control technologies to dramatically enhance air-to-air effectiveness in both within-visual-range and beyond-visual-range air combat. It will demonstrate the feasibility of a single weapon concept for both short- and medium-range missile functions, leading to a reduction in air combat weapon suite cost. The missile technology basis for producing an offensive sphere around the launch aircraft will allow successful target intercepts without regard to target off-boresight angle or target orientation. The program will demonstrate dramatically expanded weapon engagement zone over AIM–9X and AMRAAM combined. The FY02 goal is to demonstrate the ability to intercept maneuvering targets at 40 mi head-on, 25 mi to beam, and 12 mi to rear of launch aircraft, and to demonstrate the ability to intercept high off-boresight, post-merge targets inside a 1,000-ft one-circle flight in less than 5 seconds of flight time.

The Air Superiority Missile Technology (ASMT) concept consists of a reduced drag, wingless AMRAAM airframe modified with main propulsion chamber-bleed reaction jet controls positioned aft of the reduced span tail fins. The ASMT concept allows stable flight at angles of attack up to 90 deg, using robust reaction jets to rotate the missile to the rear hemisphere slightly over 2 seconds after launch; the reaction jet assembly also provides critically needed missile roll control. The reaction jets are only used when necessary for high off-boresight maneuvers and have no impact on beyond-visual-range flight performance. The current box size for the ASMT concept is 9.5", as compared to the 12.5" box size of the clipped-fin AIM–120C. Production cost estimates for a conceptual tactical weapon employing ASMT technologies indicate a cost impact relative to nominal AMRAAM of less than 4% of the total missile cost.

By FY02, the program will demonstrate increased f-pole, decreased inner boundary, increased average velocity, increased maneuverability, increased high-altitude controllability, decreased box size, and increased maximum flyout range over both AIM–9X and AIM–120C. Program milestones include: by FY98, developing an agile-AMRAAM missile design that uses reaction jet/tail fin control, and conducting manned air combat evaluations; by FY01, fabricating sufficient test articles through ground tests in preparation for unguided flight demonstrations; and by FY02, conducting unguided flight demonstrations of the advanced airframe concept, and developing seeker integration designs for an electronically steered conformal array seeker under parallel development. Technical barriers include reaction jet control implementation onto inventory AMRAAM rocket motors, reaction jet response time less than 10 milliseconds, stable flight of modified AMRAAM at a 90-deg angle of attack, compact packaging of all new technologies within the length/weight constraints of F–22 weapons bay, and development of over-the-shoulder guidance methodologies.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602602F	2068	0.5	1.2	2.6	1.2	1.6	0	0
0603601F	670A	0.1	2.6	2.7	4.4	3.4	2.2	0
	Total	0.6	3.8	5.3	5.6	5.0	2.2	0

WE.38.02 ***Highly Responsive Missile Control.*** By FY99, this DTO will demonstrate, through a series of simulations and test flights, substantial improvements in maneuverability and response time by implementing integrated guidance and control systems via new design techniques to provide response times that are less than one-third that of current missiles and lateral maneuver levels that are twice that of current ship defensive missiles. Flight testing and simulations will demonstrate the advanced guidance and control design concept. Simulation will provide the design tools necessary to predict estimated performance levels, while flight testing will be used to validate simulations and demonstrate performance. Simulations, particularly hardware-in-the-loop simulations, will provide the final demonstration of the overall concept by FY98. (Simulation must be used because there is no target capable of exercising the system as the projected threat would.) The preferred missile airframe for use is the Standard Missile Blk IV variant and will provide a number of advantages including an available aerodynamic database and an advanced signal processing throughput capability

The expected products for transition of this advanced technology demonstration include a new autopilot design through the use of robust optimization techniques; a new guidance filter and guidance law design integrated with the autopilot to substantially reduce the overall guidance time constant; and an increase in maneuverability through the accommodation of cross-coupling effects at high angles of attack and structural strength of critical missile components. Additional benefits include improved performance against targets, jammers, and decoys, and application to hit-to-kill interceptors.

Key demonstrations include projected missile capability and technical objectives, time response improvements, guidance filter performance, and 6-DOF simulation (FY96); subsystem test results, flight software performance, and hardware-in-the-loop and 6-DOF simulations (FY97); and flight tests and results, guidance performance, and EMD readiness (FY98).

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	4.8	6.5	3.4	0	0	0	0
	Total	4.8	6.5	3.4	0	0	0	0

WE.39.02 ***Tactical Missile Propulsion.*** This effort includes technology advances in the areas of propellants, propellant management devices, combustion and energy conversion devices, and control systems. The overall goal is to double rocket propulsion capability by the year 2010. This will support the warfighter by allowing weapon systems designs with greater range, reduced signature, improved survivability, increased payloads, enhanced lethality, and more rapid response than currently available. The logistical burden will be reduced due to more capable weapons. Inert components have a primary effect on mass fraction improvement capabilities. High strength-to-weight, low-erosion, and lighter weight materials are required to improve missile performance by reducing component weights and improving their performance. High-energy propellants with high densities are also required to increase the delivered energy of the system. Multimission missiles require a new generation of smart propulsion capable of instantaneous response to the demands of new electronic "brains." Rapid retargeting, expansion of the no-escape zone, and the ability to redirect to a higher value target in flight will be possible. Propulsion systems will be available to demonstrate a reduction in the number or size of theater missile defense systems to cover a given area. Potential system payoffs, based on a constant system weight and volume, include payload increases of 10% (FY00), 25% (FY05), and 100% (FY10); range increases of 10% (FY00), 30% (FY05), and 100% (FY10); and decreases in required TMD interceptors of 26% (FY00), 45% (FY05), and 60% (FY10). Increased missile payload capability can be directly traded for increased range and decreased time-to-target. This effort is a part of the joint Army, Navy, Air Force, and NASA Integrated High-Payoff Rocket Propulsion Technology Program.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603792N	R1889	11.2	9.0	5.0	0	0	0	0
0602111N		3.0	3.5	3.4	3.0	0	0	0
0602303A	A214	1.8	2.1	2.1	2.1	0	0	0
0602601F	602A	3.2	3.5	3.1	3.1	0	0	0
0603302F	6339	0.3	0.3	0.3	0.3	0	0	0
	Total	19.5	18.4	13.9	8.5	0	0	0

WE.40.08 ***Infrared Decoy Technology.*** The objective, by FY00, is to develop and demonstrate IR decoy technology using captive IR seekers in air and sea applications. In FY98, the program will demonstrate advanced IR decoy technology and techniques providing a 25% improvement in protection against advanced strategic- and tactical-expendable (ASTE) Tier II threats. This will be accomplished by demonstrating a 25 times improvement in the aerodynamic properties of special materials decoys and by demonstrating flare materials with more energy in the mid-wave than short-wave bands. (Current decoy technology cannot provide these capabilities.) These devices will then be applied in advanced flare-dispensing techniques using multiple expendables to meet ASTE goals. In FY00, the program will demonstrate advanced ship protection with decoys that provide a 20 times improvement in spatial extent while retaining sufficient mid-wave and long-wave intensity to decoy antiship cruise missiles. Current technology can only provide point source protection that does not replicate the spatial extent of the ship. Also in FY00, IR decoy dispensing technique will be developed providing protection against three classified IR missile threats with counter-countermeasures. IR decoy efforts beyond FY00 will be integrated into the demonstrations under WE.47 (I^2R Seeker CM). Successful achievement of this DTO will enhance the survivability of airborne and sea platform combatants against the sophisticated class of advanced IR missiles with advanced decoy rejection techniques/algorithms.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602270N		0.8	0.9	0.9	1.0	0	0	0
0603270N	E2194	2.8	3.5	1.7	0.6	0	0	0
0602204F	2000	0.3	0.3	0.4	0.4	0	0	0
0603270F	2222	1.3	0	0	0	0	0	0
0603270F	691X	0.5	1.2	0.6	0	0	0	0
	Total	5.7	5.9	3.6	2.0	0	0	0

WE.41.04 ***Multimission Space-Based Laser.*** This DTO will develop and demonstrate space-based laser (SBL) technology to support a system development decision for a multimission SBL (theater missile defense, national missile defense, ASAT, surveillance, target designation, and active and passive target discrimination). Previously demonstrated technologies—MW-class Alpha HF chemical laser, Large Aperture Mirror Program (LAMP) 4-m segmented telescope, and Large Optics Demonstration Experiment (LODE) outgoing wave beam control technologies—will be integrated in the Alpha/LAMP Integration (ALI) demonstration to be completed in FY98. The High-Altitude Balloon Experiment (HABE) will demonstrate, at low power in the target environment, a complete acquisition, tracking, and pointing suite scaleable to SBL operational requirements. The primary remaining technical issues for SBL involve integration of hardware components into a lightweight, flight-ready configuration for final ground tests and an optional space flight/demonstration (SHIELD/Readiness Demonstration program), and integration of the target acquisition and tracking system which will have been demonstrated in the HABE program. LAMP and LODE technologies are currently being integrated in a vacuum chamber (for space simulation) adjacent to the current Alpha vacuum chamber. In FY98, ALI will demonstrate integrated generation, stabilization, and projection of a megawatt-class high-power laser beam. Critical parameters of beam quality, wavefront error, and jitter will achieve near-weapon-scale performance with power and aperture area at one-fourth the scale of an operational SBL system. Advanced technology demonstrations to increase brightness, such as phase conjugation and operation at HF overtone, will be conducted in FY03. An uncooled remotely aligned Alpha laser resonator will be completed in FY00 and tested in FY01.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0603173C	1360	98.5	29.0	28.7	28.4	27.8	28.4	28.0
	Total	98.5	29.0	28.7	28.4	27.8	28.4	28.0

WE.42.08 ***Laser Aircraft Self-Protect Missile Countermeasures.*** This DTO will develop and demonstrate laser system technologies for a damage/destroy (D2) laser weapon to counter the next generation of advanced guided surface-to-air and air-to-air threats. Moderate-power laser device and beam control technology will be used to demonstrate a robust capability to negate guided missiles by damaging/destroying the seeker. A FY99 field demonstration will be conducted initially against static missiles. The program will demonstrate, by FY01, a D2 prototype laser/beam control system on a large aircraft platform. This program will be a coordinated Army/Navy/Air Force effort to address self-protection for large aircraft and helicopters against next-generation advanced missiles. This will provide a more robust countermeasure than conventional jamming, but requires a higher power laser and necessary effects database.

The program also will develop, by FY01, Fotofighter laser technology by combining technology development for semiconductor laser diodes, coherent laser diode array architectures, and electronic beam steering into a demonstration of moderate- to high-power laser systems which can be constructed as conformal arrays of phased, electronically steerable diode lasers in the skin of an advanced aircraft. This demonstration will establish the technology for low-drag, compact, high-efficiency laser weapons for use in both offensive and defensive roles. Fotofighter provides an all-aspect capability for air-to-air and air-to-surface engagements. Technology advances needed include wide-angle beam steering, high-power thermal control of laser arrays, and wavelength versatile semiconductor laser materials. The criterion for success is demonstration of a building-block, kilowatt-class, phased-array-laser module for scaling to multikilowatt applications. The program will demonstrate, by FY05, kilowatt-level, short-wavelength, phased-laser arrays and by FY06, 100-W IR phased laser arrays.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	3326	2.8	5.8	5.3	4.6	4.5	4.6	4.7
0603605F	3151	4.4	3.9	6.6	8.0	9.3	9.7	10.1
	Total	7.2	9.7	11.9	12.6	13.8	14.3	14.8

WE.43.08 ***Advanced Multiband Infrared Countermeasures Laser Source Solution Technology.*** Countermeasures against the current threat of advanced IR-guided surface-to-air and air-to-air missiles will require laser sources to provide the precisely directed, high-intensity beams of coherent mid-IR jamming energy. Current incoherent IR jamming sources (lamps) are relatively large, heavy, and inefficient and can only be installed on larger fixed- and rotary-wing aircraft. Nearer term laser sources now under development offer higher jamming intensities, but require relatively inefficient optical conversion into some of the required mid-IR bands; and their size, weight, and power requirements are still too large for installation in tactical fixed-wing aircraft and smaller rotary-wing aircraft. However, semiconductor laser diode technologies offer the potential of very high electrical efficiency and brightness, light weight, and compact packaging that can make advanced laser countermeasures readily packageable for installation in tactical fixed- and rotary-wing aircraft.

This program will develop and demonstrate a three-band, packaged mid-infrared semiconductor laser system. The focus of the Multiband IRCM Laser Source Solution (MISS) effort will be fixed-wing and rotary-wing IRCM programs. The principal technology issues are development of high-brightness, high-operating-temperature Band IV laser diodes, and development of novel resonator configurations for current-generation Band I and II laser diodes. The metrics for this program will be far-field brightness in the mid-IR bands of interest and weight/volume and electrical power requirements of the IRCM system. Specific performance goals are a factor of three improvement in the brightness over current generation Band IV semiconductor lasers and a 50 K increase in the operating temperature for Band IV laser output. This program will be a coordinated Army/Navy/Air Force effort to develop and demonstrate semiconductor laser technology for advanced IR missile threats.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602601F	3326	0	1.5	1.0	0.5	0	0	0
0603605F	3151	0	2.0	3.0	3.0	0	0	0
	Total	0	3.5	4.0	3.5	0	0	0

WE.45.07 ***Sea Mines.*** This DTO will demonstrate a minefield concept to completely monitor and control a designated ocean battlespace through the application of new technology in advanced multisensor fusion for target detection, classification, and tracking: inter-mine and intra-field communications networks to add effectiveness; and mine/minefield remote control (RECO) for strategic flexibility. Sea mine technology efforts will integrate advanced magnetic field, electric field, acoustic, and pressure sensors to support a mine actuation decision. Specific demonstrated capabilities include acoustic and electromagnetic sensors capable of detecting slow, quiet surface ships and submarines to a range of 1,000 m; sensor fusion algorithms capable of accurate localization and tracking of targets over the mine/sensor field; automated classification of targets detected by the mine/sensor field; command node to implanted mine communications (two-way) to support full RECO of minefields; and autonomous distributed network control to support optimization of communications and processing functions with extended lifetime.

Milestones include, in FY97, demonstrate detection, classification, and localization of quiet submarines and surface ships at medium water depths (150–600 ft); in FY98, demonstrate shallow- and intermediate-water-depth, low-data-rate communications between mines/relay nodes, and use of low-cost acoustic transmitters/receivers to ranges of up to 10 nmi; by FY99, demonstrate the ability to accurately classify targets detected by a suite of acoustic and nonacoustic sensors integrated into sensor nodes in a sensor field; by FY00, demonstrate multiple concepts for RECO connectivity from manned air, surface, and subsurface command platforms to shallow-water planted mines; by FY01, demonstrate in a virtual laboratory environment, using actual autonomous node hardware embedded in a virtual simulation environment, an armed autonomous network capability; and by FY03, demonstrate the feasibility of a minefield with the effectiveness, flexibility, and RECO capability provided by an intelligent, intercommunicating sea minefield/distributed surveillance network concept.

Technical barriers include underwater detection of quiet targets; automated classification of targets; multisensor node coordination and real-time target decision algorithms; very shallow water underwater communications at tactically significant ranges; autonomous network control/coordination protocols; safe, reliable, low-volume/-weight, high-energy, long-life batteries; and data management.

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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602315N		3.1	3.5	3.6	3.6	3.6	0	0
	Total	3.1	3.5	3.6	3.6	3.6	0	0

WE.46.08 ***Coherent RF Countermeasures Technology.*** A coherent CM capability is required to protect friendly airborne and surface platforms by degrading or confusing sophisticated hostile RF threat sensors. Traditional noncoherent techniques, such as noise jamming, are largely ineffective against modern coherent threats. Digital RF memory (DRFM) has the ability to accurately store, replicate, and manipulate coherent signals for retransmission, thus degrading the threat sensor's ability to engage. Microwave power modules (MPMs) offer ten times the reduction in volume and two times the improvements in efficiency over typical vacuum-tube-based transmitters. The FY97 goal is to demonstrate a 2 x 8 MPM transmit array and finalize a tri-service DRFM standard architecture. By FY98, the program will demonstrate coherent jamming using a two-channel monolithic "DRFM-on-a-chip," including miniature techniques on three 6" x 9" circuit cards. The program will demonstrate a critical polarization-agile MPM transmitter in both array and towed decoy configurations to precisely match jammer polarization to coherent threats—and determine the optimal arrayed configuration for planned airborne pod implementation. The goal is to initiate development of a 15-in^3 transceiver compatible with DRFM technology to form the building block to a coherent jammer by FY99. By FY00, the program will integrate transceiver, monolithic DRFM, and technique controller to form a coherent RF exciter. By FY01, development of a tri-service brassboard and a coherent countermeasures jamming pod technology demonstrator/ATD will be initiated integrating the DRFM, transceiver, MPM array, and controller technologies. The bottom line of this emerging technology DTO is that coherent countermeasures are applicable to both self-protection and support jamming roles, thus enhancing the tri-service survivability of surface combatants/warfighters and penetrating/interdicting aircraft.

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0602270A	A442	1.1	0.9	1.0	0	0	0	0
0602270N		0.8	0.9	1.0	1.0	1.1	1.2	1.2
0603270F	691X	0	0.5	2.0	1.0	0.5	0	0
0603270F	431G	1.9	1.9	3.7	5.1	9.1	9.5	9.9
0602204F	2000	0.8	0.8	0.2	0.2	0.2	0.2	0.2
0602270N		0.6	0.6	0.7	0.7	0.7	0.7	0.8
	Total	5.2	5.6	8.6	8.0	11.6	11.6	12.1

WE.47.08 ***Imaging Infrared Seeker Countermeasures Technology.*** This Imaging Infrared (I^2R) Seeker CM DTO will develop requirements for and demonstrate the effectiveness of countermeasures to defeat focal-plane-array-based imaging seekers. These seekers will be found on the next generation of antiair and antiship missile threats. Imaging seekers represent a significant improvement in seeker target acquisition, target identification, and infrared counter-countermeasure (IRCCM) capability. Current IRCM techniques have been demonstrated to be less than 1–2% effective against imaging seekers. Specific advanced threat technologies will be assessed and quantifiable requirements developed for advanced expendables, lasers, and signature control techniques for antiair and antiship protection to improve effectiveness of countermeasures by 40–50 times. DTO goals include developing a reconfigurable imaging seeker digital model by FY98; assessing effectiveness of potential countermeasure techniques against modeled threats using expendables and lasers by FY99; evaluating signature control techniques to deny acquisition against modeled threats by FY99; measuring IRCM vulnerability using jamming and damage lasers of foreign and domestic focal planes by FY00; and testing and demonstrating countermeasure devices against imaging seeker hardware (surrogate or real) by FY02. Defeating these missile threats may require directional jammers with two to three times more powerful lasers or beams with one-half to one-third the divergence requiring two to three times more precise pointing and tracking. Area decoys encompassing ten times more area than existing or near-term developmental devices will be required to obscure the target. It is anticipated that all techniques must be brought to bear in cooperative fashion to defeat imagers. The work supports service laser-based countermeasure programs as well as advanced expendable development work and will encompass countermeasure and threat technology available in the FY00–02 timeframe.

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PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602270A	A442	0.2	0.3	0	0	0	0	0
0602270N		0.5	0.5	0.5	0.4	0.4	0.3	0.3
0603270F	691X	0.3	0.8	0.9	1.0	0.6	0.6	0
0602204F	2000	0	0.2	0.2	0	0	0	0
0603270N	E2194	0	0	0.7	0.7	0.8	0	0
	Total	1.0	1.8	2.3	2.1	1.8	0.9	0.3

WE.48.08 ***Missile Warning Sensor Technology.*** This DTO will demonstrate advanced multispectral sensor technology that will detect incoming guided IR missile threats at long ranges. Current missile warning technology limits detection to the last few seconds of the engagement, at which point platform survivability is jeopardized. Detection ranges must be extended and false alarms reduced (2–10 times) to provide unambiguous warning in time to initiate effective tactical maneuvers, deploy countermeasure decoys, or cue directed-energy jamming systems. Specific and quantifiable technology advancements in cryogenically cooled and uncooled detectors, multiaperture packaging, and real-time algorithms are required to provide affordable systems for all warfighter platforms. DTO goals focusing on detection range, specifically, are to demonstrate a two times increase by FY98, five times by FY00, and ten times by FY02. In FY99, the program will perform a live fire test of new SAM and ATGM detection algorithms. By FY00, the program will demonstrate $150,000 per ship-set MWS (based upon uncooled IR focal plane array technology) yielding a two times detection range improvement over UV systems and a minimum two times improvement in false alarm rate over other IR warning systems. By FY01, the program will demonstrate the integration of currently independent functions (missile warning, defensive IRST, navigation) into a single aperture achieving a 50% reduction in avionics system volume and a 3:1 reduction in apertures (six sensor systems versus four to six sensors per system). For aircraft applications—the most severe test of tactical aircraft performance requirements versus allowable life-cycle cost—anticipated production costs will be held to two times the current system. Achievement of this DTO will enable multiple transitions to new/retrofit platforms, including Joint Strike Fighter, Common Missile Warning P^3I, the Army's Top-Attack Protection Program, and Navy ship self-protection upgrades. The bottom line for the Joint Warfighter is greatly improved survivability, with a totally passive intercept/situational awareness capability.

Service/Agency POC	Service/Agency POC	USD(A&T) POC	Customer POC
Dr. Preston Grounds ONR-313 (703) 696-0561 Fax (703) 696-1331 groundp@onrhq. onr.navy.mil	Mr. Ray Irwin AMSEL-RD-NV-SR-OD (908)427-4589 Fax (908) 427-2493	Dr. C. W. Kitchens, Jr. DDR&E/WT (703) 695-9602 Fax (703) 695-4885 kitchecw@acq.osd.mil	Ms. Barbara Kohls ASC/LNWP (937) 255-4811 x3730 Fax (937) 255-7743 kohlsbv@rerw. wpatb.af.mil
LtCol John Haynes SAF/AQRT (703) 602-9200 x24 Fax (703) 602-9199 haynesj@saf. pentagon.mil			Mr. William Allen NAVSEA, PEO (TAD) (703) 602-7740 x408 Fax (703) 602-2400 allen_william@hq. navsea.navy.mil

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602270A	A442	0.1	0.3	1.0	0	0	0	0
0602270N		0.4	0.5	0.7	0.7	0.8	0.8	1.0
0603270N	E2194	1.4	3.3	3.3	3.4	3.5	3.5	3.5
0603270F	691X	0.7	0.8	1.4	0.9	0	0	0
	Total	2.6	4.9	6.4	5.0	4.3	4.3	4.5

WE.50.02 ***Compact Kinetic Energy Missile.*** This DTO will demonstrate the compact kinetic energy (KE) missile technology necessary for a LOSAT P^3I. The LOSAT P^3I will match the lethality of the LOSAT while reducing the LOSAT takeoff weight by 40–50%, missile diameter by 20%, minimum range to peak velocity by 40–50%, and provide the maneuver capability required to destroy attacking fixed- and rotary-wing aircraft. The program will demonstrate compatibility with the LOSAT target acquisition and tracking system and could be compatible with the fire control system for close combat and short-range air defense missions.

Specific demonstrated capabilities are to deliver M829A2-equivalent KE at 175 m and maintain as a minimum that level of energy to beyond 5 km with the advanced KE penetrator delivered by a lightweight (35–40 kg) miniature hypervelocity KE missile. The program will demonstrate the missile, which accelerates to a peak velocity of 2,200 m/s and delivers in excess of 30 MJ to the target at a range of less than 500 m out to a range of 4 km, and 25 MJ at 5 km. The propulsion system will meet joint service insensitive munitions requirements.

Milestones include demonstrating motor and propulsion concepts by FY98; novel penetrators integrated with the airframe by FY00; and a miniaturized, hardened inertial guidance system by FY01. Flight tests will be conducted in FY03.

Technical barriers include: development and integration of miniaturized guidance and continuous control actuation technology, application of advanced composite technologies in high-performance propulsion systems, fire control, propulsion technologies, and enhanced lethality effects from advanced KE penetrator designs.

Service/Agency POC	USD(A&T) POC	Customer POC
Robert Reisman SARD-TT (703) 695-1447	Dr. C. W. Kitchens, Jr. DDDR&E/WT (703) 695-9602 Fax (703) 695-4885 Kitchecw@acq.osd.mil	Col T. Bosse (Lead) Dismounted Battlespace Battle Lab (706) 545-2310 Col J. Gribshaw Anti-Tank TRADOC Sys. Mgr. (706) 545-5510

Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602303A	A214	1.5	2.5	2.0	0	0	0	0
0603313A	D655	0	0	0	3.4	6.0	10.7	9.8
	Total	1.5	2.5	2.0	3.4	6.0	10.7	9.8

WE.51.02 ***Small Diameter Antiair Infrared Seeker.*** This DTO will develop and demonstrate a small diameter (2.75") IR imaging seeker that can provide improved target engagement capability for man-portable and lightweight crew-served air defense missile systems. This will enable air defense missiles such as Stinger to engage targets at long ranges in the presence of ground clutter. Specifically, this improved form-factored seeker with breadboard electronics utilizing a state-of-the-art midband IR focal plane array will demonstrate in tower and captive carry tests, by the end of FY97, the ability to engage helicopter targets in terrain clutter at ranges in excess of three times the present capability. By the end of FY99, the program will develop a completely form-factored seeker (including electronics) suitable for flight tests incorporating advanced signal processing algorithms with IR CCM, and demonstrate through tower and captive carry tests the ability of this seeker to acquire helicopters, fixed-wing aircraft, cruise missiles, and unmanned aerial vehicles in hostile environments at ranges in excess of present capabilities.

Technical barriers include achieving effective engagement range capability against the full target set, developing and packaging the complete seeker including electronics in a 2.75" missile-compatible size, demonstrating advanced IR CCM capability against known projected countermeasures, and achieving operational and computability with a rolling airframe missile.

Service/Agency POC	**USD(A&T) POC**	**Customer POC**	
Robert Reisman	Dr. C. W. Kitchens, Jr.	LTC Tom Newberry	Chris Kearns
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Programmed DTO Funding ($ millions)

PE	Project	FY97	FY98	FY99	FY00	FY01	FY02	FY03
0602303A	A214	0.7	0	0	0	0	0	0
0603313A	D549	0	2.9	2.9	0	0	0	0
	Total	0.7	2.9	2.9	0	0	0	0

APPENDIX

GLOSSARY OF ABBREVIATION AND ACRONYMS

APPENDIX

GLOSSARY OF ABBREVIATION AND ACRONYMS

This glossary is a consolidation of all abbreviations and acronyms used in the *Joint Warfighting Science and Technology Plan,* the *Defense Technology Area Plan*, and this DTO.

2D	two dimensional
3D	three dimensional
3rdGARD	3rdGARD Advanced Rotor Demonstration
4D	four dimensional (three dimensional plus time)
µm	micrometer

A

AA	antiarmor
AAAV	Advanced Amphibious Assault Vehicle
AAM	air-to-air missile
AATP	advanced airframe technology plan
AAV	autonomous air vehicle
AAW	active aeroelastic wing
ABCA	America–Britain–Canada–Australia
ABIS	Advanced Battlespace Information System
ABL	airborne laser
A/C	aircraft
ac	alternating current
ACBL	amphibious cargo beaching lighter
ACCM	advanced cooperative collection management
ACE	aerospace chromium elimination
ACEM	Advanced Common Electronic Modules
ACIS	Aircrew Integrated Systems
ACPT	Air Campaign Planning Tool/Toolkit
ACOM	Atlantic Command
ACT II	Advanced Concept Technology II
ACTD	Advanced Concept Technology Demonstration
ACR	advanced concepts and requirements
ACUS	Area Common User Systems
A/D	analog to digital
ADATS	Adjustable Diversity Acoustic Telemetry System
ADC	Acoustic Device Countermeasure; analog-to-digital conversion/ converter
ADCAP	advanced capability
ADN	an explosive ingredient
ADSAM	air-directed surface-to-air missile
ADVEDS	Advection and Dispersion of Vapor, Evaporating Droplets and Solids model
AEDC	Arnold Engineering Development Center
AEW	airborne early warning
AF	Air Force
AFATDS	Advanced Field Artillery Tactical Data System
AFFTC	Air Force Flight Test Center (Edwards AFB, CA)
AFGROW	a deterministic fatigue analysis and failure prediction model
AFSATCOM	Air Force Satellite Communications Command
AFSCN	Air Force Satellite Control Network
AFSPC	Air Force Space Command
AGARD	Advisory Group for Aerospace Research and Development
AGE	aerospace ground equipment
AGTFT	Antijam GPS Technology Flight Test
Ah	ampere-hour
AHMCM	Antihelicopter Mine Countermeasure
AI	artificial intelligence
AIEWS	Advanced Integrated Electronic Warfare System
AIN	Army Interoperability Network
AIT	Atmospheric Interceptor Technology
AJ	antijam
AJP	Advanced Joint Planning
ALC	air logistics center
ALCM	Air-Launched Cruise Missile
ALERT	air/land enhanced reconnaissance and targeting
ALI	Alpha/LAMP Integration
ALISS	Advanced Lightweight Influence Sweep System
ALMDS	Airborne Laser Mine Detection System
ALP	Advanced Logistics Program
ALSP	Aggregate-Level Simulation Protocol
AM^3	Affordable Multimission Manufacturing
AMC	U.S. Army Materiel Command
AMCM	airborne mine countermine

AMDS	Advanced Mine Detector System
AMEL	active matrix electroluminescent display
AMP	Antimine Projectile
AMPS	Advanced Mobile Phone Service
AMRAAM	Advanced Medium-Range Air-to-Air Missile
AMS	analog mixed signal
AMW	amphibious warfare
ANBCWRS	Automated Nuclear, Biological, and Chemical Warning and Reporting System
ANL	Armstrong National Laboratory
AOC	air operations center
AOSN	autonomous ocean sampling network
AP	antipersonnel
APL	antipersonnel land mine
APOD	air point of debarkation
APPEX	Advanced Power Projection and Execution
APS	active protection system
ARDEC	Armament Research, Development and Engineering Center
ARG	Amphibious Ready Group
ARIEM	Army Research Institute of Environmental Medicine
ARL	Army Research Laboratory
ARM	antiradiation missile
ART	Advanced Rotorcraft Transmission
AS	Arsenal Ship
ASAS	All-Source Analysis System
ASAT	antisatellite
ASCI	Accelerated Strategic Computing Initiative
ASCIET	All-Service Combat Identification Evaluation Team
ASCM	antiship cruise missile
ASIC	application-specific integrated circuit
ASM	air-to-surface missile
ASMD	antiship missile defense
ASMT	Air Superiority Missile Technology
ASSDC	Army Space and Strategic Defense Command
AST	Advanced Subsonic Technology
ASTAMIDS	Airborne Standoff Minefield Detection System
ASTE	advanced strategic and tactical infrared expendable
ASTOVL	Advanced Short Takeoff and Vertical Landing
ASTP	Advanced Sensor Technology Program
ASUW	antisurface ship warfare
ASW	antisubmarine warfare
AT	antitank
ATACMS	Army Tactical Missile System
ATAD	Air Target Algorithm Development
ATD	Advanced Technology Demonstration
ATEGG	Advanced Turbine Engine Gas Generator
ATF	Alcohol, Tobacco and Firearms
ATGW	antitank guided weapon
ATIRCM	Advanced Threat Infrared Countermeasures
ATIRP	Advanced Telecommunications and Information Distribution Research Program
ATM	asynchronous transfer mode
ATO	air tasking order
ATPP	advanced turbo-propulsion plan
ATR	automatic target recognition
ATSD(NBC)	Assistant to the Secretary of Defense (Nuclear/Biological/Chemical)
ATT	Antitorpedo Torpedo
AUV	autonomous underwater vehicle
AWACS	Airborne Warning and Control System
AWE	advanced warfighting experiment
AWFT	Antimateriel Warhead Flight Test

B

B3	a level of security assurance
BADD	Battlefield Awareness and Data Dissemination
BAMB	bending annular missile body
BAT	Brilliant Antitank
BC^2	battlespace command and control
BC^2A	Bosnia Command and Control Augmentation
BCHIS	Bulk Charging Hazards Interaction System
BCID	battlefield combat identification
BCIS	Battlefield Combat Identification System
BDA	battle damage assessment
BDO	battle dress overgarment
BDS–D	Battlefield Distributed Simulation–Development
BFTT	Battle Force Tactical Trainer
BFVS	Bradley Fighting Vehicle System
BIDS	Biological Integrated Detection System
BiFET	bipolar field effect trransistor
B-ISDN	Broadband Integrated Services Digital Network
BIST	built-in self-test
BLWE	Battle Lab Warfighting Experiment
BMD	ballistic missile defense
BMDO	Ballistic Missile Defense Organization
BOL	beginning of life
B/OT	boost and orbit transfer
BPI	boost-phase intercept
bps	bits per second
BRA	Basic Research Area
BW	biological warfare
BZ	beach zone

C

C&C	cut and cover
C&S	computing and software
C^2	command and control
C^2I	command, control, and intelligence
C^2V	command and control vehicle
C^2W	command and control warfare
C^3	command, control, and communications
C^3I	command, control, communications, and intelligence
C^4	command, control, communications and computers
C^4I	command, control, communications, computers, and intelligence
C^4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
CAD	computer-aided design
CAE	computer-aided engineering
CAIV	cost as an independent variable
cal/cm^2	calories per square centimeter
CAM	computer-aided manufacturing
CAP	combat air patrol
CAPS	Counteractive Protection System
CAS	close air support
CASE	computer-aided software engineering
CASTFOREM	Combined Arms Support Task Force Evaluation Model
CATOX	catalytic oxidation
CAV	Composite Armored Vehicle
CB	chemical/biological; computer-based
CBD-IMPACT	Chemical/Biological Defense Integrated Meteorological and Contamination Transport
CBN	chemical/biological/nuclear
CBU	consistent battlespace understanding
C/C	carbon/carbon
CC&D	camouflage, concealment, and deception
CCD	charged-coupled device
CCE	combined-cycle engine
CCM	counter-countermeasure
CCS	charge control system
CCTT	Close Combat Tactical Trainer
CDC	Centers for Disease Control and Prevention
CDR	critical design review
CEASE	Compact Environmental Anomaly Sensor
CEC	cooperative engagement capability
CECOM	U.S. Army Communications-Electronics Command
CENTCOM	Central Command
CEP	circular error probable
CFC	chloro-fluoro-carbon; Combined Forces Command
CFCC	continuous fiber ceramic composite
CFOR	command forces
CFR	Code of Federal Regulations
CFT	captive flight test
CGF	computer-generated force
CGS	common ground station
CIC	combat information center
CID	combat identification
CIE	clothing and individual equipment
CIMMD	close-in man-portable mine detector
CINC	commander in chief
CINCPAC	Commander-in-Chief Pacific Command
CIS	Combat Information System
CIWS	Close-In Weapon System
CJTF	Commander, Joint Task Force
CKEM	Compact Kinetic-Energy Missile
C_L	lift coefficient
CM	countermeasure; countermobility
CM/M	countermine/mine
cm^3	cubic centimeters
CMC	ceramic matrix composite
CMD	cruise missile defense
CMIP	common management information protocol
CMMS	conceptual models of the mission space
CMOS	complementary metal oxide semiconductor
CMWS	Common Missile Warning System
COA	course of action
COBRA	coastal battlefield reconnaissance and analysis
COE	common operating environment
COEA	cost and operational effectiveness analysis
COIL	chemical oxygen-iodine laser (lases at 1.3 μm)
COMNAV-AIRLANT	Commander, Naval Air Forces, Atlantic
COMPASS	Common Operational Modeling, Planning, and Simulation Strategy
CONOPS	concept of operations
CONUS	continental United States
CORBA	Common Object Request Broker Architecture
COTS	commercial off the shelf
CPA	closest point of approach
CPC	chemical protective clothing
Cpk	process capability index
CPO	chemical protective overgarment
CPRC	Counterproliferation Program Review Committee
CRDA	cooperative research and development agreement
CSS	Combat Service Support (Battle Laboratory)
CT	counterterrorism
CTAPS	Contingency Tactical Automated Planning System
CTD	concealed target detection
CTF	common technical framework
CTS	continuous transverse stub
$CuInSe_2$	copper indium selenium

CVLA	Cargo Vehicle Light Assault
CVX	Aircraft Carrier Experimental
CW	chemical warfare; continuous wave; conventional weapon

D

D2	damage/destroy
D&W	detection and warning
D/A	digital to analog
DACS	Divert and Attitude Control System
DAMA	demand assignment multiple access
DAOC	Distributed Air Operations Center
DAPKL	Diode-Array Pumped Kilowatt Laser
DARE	Data Archival and Retrieval Enhancement
DARO	Defense Airborne Reconnaissance Office
DARPA	Defense Advanced Research Projects Agency
DASIAC	DoD Nuclear Information Analysis Center—formerly Defense Atomic Support Information Analysis Center
dB	decibel
DBBL	Dismounted Battlespace Battle Laboratory
DBC	Digital Battlefield Communications
DBMS	database management system
DBS	Direct Broadcast Satellite
dc	direct current
DC-ARM	Damage Control-Automation to Reduce Manning
DCE	distributed computing environment
DCL	detection, classification, and localization
DCOR	Defense Committee on Research
DCS	Deputy Chief of Staff
DCSPER	Deputy Chief of Staff for Personnel
DDBMS	distributed database management system
DDR&E	Director, Defense Research and Engineering
DDS	direct digital synthesizer
DE	directed energy
DEA	data exchange agreement
DEEM	Dynamic Environmental Effects Model
DET	distributed explosive technology
DEW	directed-energy weapon
DF	direction finding
DHEA	dehydroepiandrosterone
DI&S	design integration and supportability
DIA	Defense Intelligence Agency
DIAL	differential absorption LIDAR
DIF	data interchange format
DIFM	digital intermediate frequency modulator
DII	Defense Information Infrastructure
DIRCM	directed infrared countermeasure
DIS	distributed interactive simulation
DISA	Defense Information Systems Agency
DISC	differential scattering
DISN	Defense Information Systems Network
DIW	detection, identification, and warning
DLA	Defense Logistics Agency
DMA	Defense Mapping Agency
DMIF	Dynamic Multiuser Information Fusion
DMSO	Defense Modeling and Simulation Office; dimethyl sulfoxide
DNA	Defense Nuclear Agency; deoxyribonucleic acid
DNAPL	dense nonaqueous phase liquid
DNAW	day, night, and adverse weather
DOA	direction of arrival
DOB	depth of burst
DOC	Department of Commerce
DoD	Department of Defense
DOE	Department of Energy
DOF	degrees of freedom
DOJ	Department of Justice
DOL	Department of Labor
DOT	Department of Transportation
DPE	Defensive Planning and Execution
DRB	Division Ready Brigade
DRE	ducted rocket engine
DRFM	digital radio frequency modulator/ memory
DS2	decontamination solution 2
DSA	Depth and Simultaneous Support Battle Laboratory
DSB	Defense Science Board
DSCS	Defense Satellite Communications System
DSI	Defense Simulation Internet
DSP	Defense Support Program; digital signal processing
DSS	Decision Support System
DSTAG	Defense Science and Technology Advisory Group
DSUP	defense system upgrade
DSWA	Defense Special Weapons Agency
DT&E	development, test and evaluation
DTAP	*Defense Technology Area Plan*
DTED	Digital Terrain Elevation Data
DTO	Defense Technology Objective
DU	depleted uranium
DUSD	Deputy Under Secretary of Defense
DUSD(AT)	Deputy Under Secretary of Defense (Advanced Technology)
DUSD(ES)	Deputy Under Secretary of Defense (Environmental Security)
DVE	drivers vision enhancer
DVI	data/voice integration
DW	deep water (> 200 ft)
DWHRP	Defense Women's Health Research Program

E

EA	electronic attack
EC	electronic combat
ECCM	electronic counter-countermeasure
ECM	electronic countermeasure
EDA	Electronic Design Automation
EDCS	Evolutionary Design of Complex Systems
EEE	Eastern equine encephalitis
EELS	Early Entry Lethality Survivability Battle Laboratory
EELV	evolved expendable launch vehicle
EFOG	enhanced fiber-optic guided
EEP	explosively formed penetrator
EFOGM	Enhanced Fiber-Optic Guided Missile
EFP	explosively formed projectile/ penetrator
EHF	extremely high frequency
EIRP	effective isotropic-radiated power
EIS	Engineering Information System
EISS	Electronic Integrated Sensor Suite
EIT	electronic integration technology
ELCAS	elevated causeway
ELF	extremely low frequency
ELINT	electronic intelligence
ELV	expendable launch vehicle
EM	electromagnetic
EMC	electromagnetic compatibility
EMD	engineering and manufacturing development
EM-I	Effects Manual I
EMI	electromagnetic interference
EMP	electromagnetic pulse
EMTD	Enhanced Moving Target Detection
EN-TD	Explosive Neutralization Technology Demonstration
EO	electro-optic(al)
EOB	Electronic Order of Battle
EOCM	electro-optic countermeasure
EOD	explosive ordnance demolition/ disposal
EOS	end of service; Earth Observation System
EOTDA	electro-optical tactical decision aid
EP	electronic protection
EPA	Environmental Protection Agency
EPLRS	Enhanced Position Location and Reporting System
EQ	environmental quality
ERA	explosive reactive armor
ERASER	Enhanced Recognition and Sensing Laser Radar
ERD	Extended-Range Demonstration
ERGM	Extended-Range Guided Missile
ERT	enhanced reconnaissance and targeting
ES	electronic support
ESA	electronically scanned array/antenna
ESAI	enhanced situation awareness insertion
ESM	electronic support measure
ESMB	Explosive Standoff Minefield Breacher
ESSM	Evolved Sea Sparrow Missile System
ETB	earth-and-timber bunker
ETC	electrothermal-chemical
ETEC	Enterotoxigenic *Escherichia coli*
EUCOM	U.S. European Command
EUT	early user test
EW	electronic warfare
EXCOM	Executive Committee
EXP	expendable (an engine classification)

F

FAA	Federal Aviation Administration
FAC	forward air controller
FAR	false alarm rate
FATE	Future Aircraft Technology Enhancement
FBL	fly-by-light
FCS	Future Combat System
FDA	Food and Drug Administration
FDR	Future Digital Radio
FEC	forward error correction
FED	field emission device
FEL	free electron laser
FEMA	Federal Emergency Management Agency
FET	field effect transistor
fh	flight hour
FIV	Future Infantry Vehicle
FLCD	ferro-electric liquid crystal display
FLIR	forward-looking infrared
FLOP	floating point operation
FLOT	forward line of own troops
FM&M	force management and modeling
FMBT	Future Main Battle Tank
FMST	Future Missile System Technology
FMTI	Future Missile Technology Integration
FMTV	Family of Medium Tactical Vehicles
FO	fiber-optic(s); forward observer
FOC	future operational capability
FOG	fiber-optic guided
FOTT	follow-on to TOW
FOV	field-of-view
FOWG	fiber optic wave guide
FPA	focal plane array
FPB	Fast Patrol Boat
FPRA	forecasting, planning, and resource allocation
FRSOW	fast-reaction standoff weapon
FSCS	Future Scout and Calvary System
FSU	former Soviet Union
ft/s	feet per second
FWV	fixed-wing vehicle
FWVP	Fixed-Wing Vehicle Program
FXXILW	Force XXI Land Warrior

FY	fiscal year
FYDP	Future Years Defense Plan

G

G&C	guidance and control
Ga	gallium
GaAs	gallium arsenide
GaN	gallium nitride
GAP	glycidyl azide polymer
GaSb	gallium antimony
GBL	ground-based laser
GBR	ground-based radar
GBS	Global Broadcast Services
Gb/s	gigabits per second
GCCS	Global Command and Control System
GCSS	Global Combat Support System
G–Eng	general engineering
GEO	geosynchronous Earth orbit
GEOSAT	Geosynchronous Satellite
GFLOP	giga-floating point operations
GGP	Global Guidance Package
GHz	gigahertz
GIF	guidance integrated fuzing
GIS	Geographic Information System
GloMo	Global Mobile Information System
GMLRS	Guided Multiple Launch Rocket System
GN&C	guidance, navigation, and control
GOTS	government off the shelf
GOX	gaseous oxygen
GP	guided projectile
GPADS	Guided Parafoil Air Delivery System
GPR	ground-penetrating radar
GPS	Global Positioning System
GSTAMIDS	Ground Standoff Mine Detection System
GW	gross weight

H

HABE	High-Altitude Balloon Experiment
HACT	Helicopter Active Control Technology
HAE	high-altitude endurance
HAP	hazardous air pollutant
HARM	High-Speed Antiradiation Missile
HASS	High-Accuracy Strain Sensing
HBT	heterojunction bipolar transistor
H/C	hydrocarbon
H/CF	hydrocarbon fuel
HCI	human-computer interface
HCTR	high-capacity trunk radio
HD	sulfur mustard
HDBTDC	hard and deeply buried target defeat capability
HDRRM	high-density radiation-resistant microelectronics
HEL	high-energy laser
HELSTF	High-Energy Laser System Test Facility
HEMP	high-altitude electromagnetic pulse
HEXSAT	a Nanosatellite System concept
HF	high frequency
HFSWR	High-Frequency Surface-Wave Radar
HHS	high-heat-sink
HIMARS	High-Mobility Artillery Rocket System
HIV	human immunodeficiency virus
HLA	high-level architecture
HLV	heavy launch vehicle
HM&E	hull, mechanical and electrical
HMS+	Helmet-Mounted Sight–Plus
HMSE	Helmet-Mounted Sensory Ensembles
HMT/D	helmet-mounted tracker/display
HOB	height of burst
HOGE	hover out-of-ground effect
HP	high power
hp	horsepower
HPAC	Hazard Prediction Assessment Capability
HPC	high-performance computer/computing
HPM	high-power microwave
HPSIP	Hazard Prediction Systems Integration Program
HPT	Hazard Prediction Tool
HQ	Have Quick
HRD	human resource development
HRR	high-resolution radar
HSCT	High-Speed Civil Transport
HSLA	high strength, low alloy
HSOK	hunter/standoff killer
HSR	High-Speed Research
HSS	hunter sensor suite
HSTAMIDS	Handheld Standoff Mine Detection System
HTS	high-temperature superconductor/superconducting
HUMINT	human intelligence
HWIL	hardware-in-the-loop
HY	high yield
HYDROX	fuel and oxidizer for half-length torpedo consisting of hydrogen and oxygen

I

I&W	intelligence and warning
I^2R	imaging infrared
IADS	Integrated Air Defense Simulation
IAPG	Inter-Agency Advanced Power Group
IAS	Integrated Acoustics System; Intelligence Analysis System
IBAD	Interim Biological Agent Detector
IBAS	Improved Bradley Acquisition System
IC	integrated circuit
ICAP	improved capability upgrade

ICBM	intercontinental ballistic missile
ICH	Improved Cargo Helicopter
ID	identification
ID&PE	information display and performance enhancement
IDA	Institute for Defense Analyses
IDECM	integrated depressive ECM
IEC	Integration and Evaluation Center
IEEE	Institute of Electrical and Electronic Engineers
IETM	Interactive Electronic Technical Manual
IEW	intelligence electronic warfare
IEWCS	Intelligence Electronic Warfare Common Sensor
I/F	interface
IFEM	Integrated Force and Execution Management
IFF	identification friend or foe
IFM	integrated force management
IFOG	interferometric fiber-optic gyroscope
IFOR	Implementation Force
IFSAR	interferometric synthetic aperture radar
IHPRPT	Integrated High-Payoff Rocket Propulsion Technology
IHPTET	Integrated High-Performance Turbine Engine Technology
IIR	imaging infrared
ILIR	In-House Laboratory Independent Research
IM	insensitive munition
IM&D	Information Management and Distribution
IMAD	Insensitive Munitions Advanced Development
IMAT	interactive multisensor analysis training
IMF	intelligent minefield
IMINT	imagery intelligence
IMIS	Integrated Maintenance Information System
IMS	ion mobility spectroscopy
IMU	inertial measurement unit
INC	Internet controller
IND	investigational new drug
INFOSEC	information security
InP	indium phosphorus
INS	Inertial Navigation System
INT	intgrated
I/O	input/output
IOC	initial operating capability
IP	Internet protocol
IPB	intelligence preparation of the battlefield
IPE	integrated platform electronics
IPng	Internet protocol, next generation
IPPD	integrated product and process development
IPT	integrated product team
IR	infrared
IR&D	independent research and development
IRCCM	infrared counter-countermeasure
IRCM	infrared countermeasure
IRFPA	infrared focal plane array
IRST	infrared search and track
IS	information superiority; information security
IS&T	information systems and technology
ISAR	inverse synthetic aperture radar
ISDN	Integrated Services Digital Network
Isp	specific impulse (theoretical)
ISR	intelligence, surveillance, and reconnaissance
ISS	Integrated Sensor System
IST	Information Systems Technology
ISTD	Integrated Space Technology Demonstration
ISTEF	Innovative Sciences and Technology Evaluation Facility
ISX	Information Superiority Experiment
ITALD	Improved Tactical Air-Launched Decoy
ITAS	Improved Target Acquisition System
ITODET	integrated target organ dose estimation tool
IU	image understanding
IUA	image understanding architecture
IVES	intravehicle electronics suite
IVMMD	Interim Vehicle-Mounted Mine Detector
IW	information warfare
IW-D	defensive information warfare

J

JAHUM	Joint Advanced Health and Usage Monitoring
JAMC	Joint Amphibious Mine Countermeasure
JASSM	Joint Air-to-Surface Standoff Missile
JAST	Joint Attack Strike Technology
JBC	joint battle center
JBPDS	Joint Biological Point Detection System
JBREWS	Joint Biological Remote Early Warning System
JCAD	Joint Chemical Agent Detector
JCBAWM	Joint Chemical/Biological Agent Water Monitor
JCM	joint countermine
JCOS	Joint Countermine Operational Simulation
JCS	Joint Chiefs of Staff
JCSE	joint continuous-strike environment
JDAM	Joint Direct Attack Munition
JDST	Joint Decision Support Tools
JEM	jet engine modulation
JETC	jet engine test cell
JETEC	Joint Expendable Turbine Engine Concept

JETS AOA	Joint Emitter Targeting System Analysis of Alternatives
JFACC	Joint Force Air Component Command
JHMCS	Joint Helmet-Mounted Cueing System
JIC	Joint Intelligence Center
JL	Joint Logistics
JLOTS	Joint Logistics Over the Shore
JMASS	Joint Modeling and Simulation System
JMCIS	Joint Military Command Information System
JMCOMS	Joint Maritime Communications Strategy
JMRR	Joint Monthly Readiness Report
JPATS	Joint Primary Aircrew Training System
JPO-BD	Joint Program Office for Biological Defense
JPPRTS	Joint Power Projection/Real-Time Support
JPS	Joint Precision Strike
JPSD	Joint Precision Strike Demonstration
JRAMS	Joint Readiness Automated Management System
JROC	Joint Requirements Oversight Council
JSA	Joint Strike Aircraft
JSGPM	Joint Service General-Purpose Mask
JSIMS	Joint Simulation System
JSLIST	Joint Service Lightweight Integrated Suit Technology
JSLSCAD	Joint Service Lightweight Standoff Chemical Agent Detector
JSNBCRS	Joint Service Nuclear, Biological and Chemical Reconnaissance System
JSOW	Joint Standoff Weapon
JSTARS	Joint Surveillance Target Attack Radar System
JTA	Joint Technical Architecture
JTAGG	Joint Turbine Advanced Gas Generator
JTAV	Joint Total Asset Visibility
JTCTS	Joint Tactical Combat Training System
JTDE	Joint Technology Demonstrator Engine
JTF	Joint Task Force
JTMD	joint theater missile defense
JTR	joint training readiness
JTR	Joint Transport Rotorcraft
JV 2010	*Joint Vision 2010*
JWARN	Joint Warning and Reporting Network
JWARS	Joint Warfare Simulation
JWCO	Joint Warfighting Capability Objective
JWE	Joint Warfighting Experiment
JWID	Joint Warrior Interoperability Demonstration
JWP	Joint Warfighting Panel
JWSTP	*Joint Warfighting Science and Technology Plan*

K

K	kelvin
KB	knowledge base
kb/s	kilobits per second
KE	kinetic energy
KEAS	knots equivalent airspeed
kg	kilograms
kHz	kilohertz
km	kilometers
ksps	thousand samples per second
kW	kilowatts

L

LAD	Logistics Anchor Desk, large area decontamination
LADAR	laser radar
LAMIDS	Lightweight Multispectral Countermine Detection System
LAMP	Large Aperture Mirror Program
LANL	Los Alamos National Laboratory
LANTIRN	Low-Altitude Navigation Targeting Infrared for Night
LAV	light armored vehicle
LB/TS	Large Blast/Thermal Simulator
lbf	foot-pound-force
LBVDS	Lightweight, Broadband, Variable-Depth Sonar
LCAC	landing craft air cushion
LCC	life cycle cost
LCD	liquid crystal display
LCPK	low-cost precision kill
LDUUV	Large-Diameter Unmanned Undersea Vehicle
LELFAS	long-endurance, low-frequency active source
LEO	low Earth orbit
LES	(DISA) Leading Edge Services (Network)
LGW	laser-guided weapon
LHT	Lightweight Hybrid Torpedo
Li	lithium
LIC	low-intensity conflict
LIDAR	light detection and ranging
LLS	laser line scan
LMF	Laser Microfusion Facility
LMRS	Long-Term Mine Reconnaissance System
LO	low observable
LOCAAS	low-cost antiarmor submunition
LODE	Large Optics Demonstration Experiment
LOS	line of sight
LOSAT	Line-of-Sight Antitank
LOX	liquid oxygen

LPD	low probability of detection
LPI	low probability of intercept
$LRAS^3$	Long-Range Advanced Scout Surveillance System
LRS	littoral remote sensing
L/V	lethality/vulnerability
LV	launch vehicle
LW	Land Warrior
LWIR	long wavelength infrared

M

M	Mach number; mega
m	meters
M&S	modeling and simulation
MAE	medium-altitude endurance
MAJCOM	U.S. Air Force Major Command
MALD	miniature air-launched decoy
ManTech	manufacturing technology
MAP	mission area plan
MARPOL	marine pollution
MAT	Multimode Airframe Technology
MATCH	Modular Appliance Technologies, Centralized Heating
MATV	Multi-Axis Thrust Vectoring
MBE	molecular beam epitaxy
Mb/s	megabits per second
MBS	Mounted Battlespace Battle Laboratory
MC&G	mapping, charting, and geodesy
MCA	multichannel architecture; multichip assembly
MCC	microclimate conditioning; Microelectronics and Computer Technology Consortium
M/CM	mobility/countermobility
MCM	mine countermeasure; multichip module
MCOPS	Maritime Campaign Operations Planning System
MCS	Maneuver Control System
MCT	MOS-controlled thyristor; mercury cadmium telluride
MEA	More Electric Aircraft; Munitions Effectiveness Assessment
MEADS	medium extended air defense system
MEMS	microelectromechanical systems
MEP	marine enhancement program
MERS	Multifunction Electromagnetic Radiating System
MERWS	Modular Erectable Rigid Wall Shelter
MESFET	metal semiconductor field effect transistor
MFLOP	mega-floating point operations
MFOM	MRLS family of missiles
MGR	miniature GPS receiver
MH/K	mine hunter killer
MHz	megahertz
MIC	mid-intensity conflict
MICLIC	mine clearing line charge
MICOM	U.S. Army Missile Command
MILSATCOM	military satellite communications architecture
MILSTAR	military strategic, tactical, and relay (satellite)
MIMU	miniature inertial measurement unit
MISS	Multiband IRCM Source Solution
MIT	Massachusetts Institute of Technology
MITL	man-in-the-loop
MIW	mine warfare
MJ	megajoules
MLRS	Multiple-Launch Rocket System
MLS	multilevel security
mm	millimeters
MMC	metal-matrix composite
MMIC	monolithic microwave integrated circuit
MMITS	Modular, Multifunction Information Transfer System
MMPM	millimeter-wave power module
MMS	Marine Mineral Survey
MMT	miniaturized munition technology
MMW	millimeter wave
MNS	Mine Neutralization System; Mission Need Statement
MOA	memorandum of agreement
ModSAF	Modular Semiautomated Force
MOE	measure of effectiveness
MOM	measure of merit
MOS	metal oxide silicon
MOU	memorandum of understanding
MOUT	Military Operations in Urban Terrain
M/P	Materials/Processes
MPa	megapascals
mph	miles per hour
MPM	microwave power module
MPP	massively parallel processors
MPT	manpower, personnel, and training
MPTB	Microelectronics and Photonics Test Bed
MRC	major regional conflict
MRCI	Modular Reconfigurable C^4I Interface
MRE	meal ready to eat
MRL	multiple rocket launcher
MRLS	Multiple Rocket Launcher System
m/s	meters per second
MSCM	multispectral countermeasure
MSD	multisite damage
MSE	Mobile Subscriber Equipment
MSEA	Modeling and Simulation Executive Agent
MSP	military space plane
Msps	mega samples per second
MSRR	Modeling and Simulation Resource Repository
MSTAR	Moving and Stationary Target Acquisition and Recognition
MSTI	Miniature Seeker Technology Integration

MSX	Midcourse Experiment
MTAS	Molecular Toxicity Assessment System
MTBF	mean time between failure
MTBR	mean time between replacement; mean time between removal
MTI	moving target indicator
MTV	Mobile Test Vehicle
MUDDS	Multisensor Underwater Debris Detection System
MUDSS	Mobile Underwater Debris Survey System
MW	megawatts
MWIR	mid-wavelength infrared
MWS	missile warning system

N

NAC	National Automotive Center
NaS	sodium sulfur
NASA	National Aeronautics and Space Administration
NASM	National Air and Space [Warfare] Model
NATO	North Atlantic Treaty Organization
NAVAIR	Naval Air Command
NAVOCEANO	Naval Oceanographic Office
NAVSEA	Naval Sea Systems Command
NAVSPACECOM	Naval Space Command
NBC	nuclear/biological/chemical
NCAR	National Center for Atmospheric Research
NCCOSC	Naval Command, Control and Ocean Surveillance Center
NCTR	noncooperative target recognition
NDCEE	National Defense Center for Environmental Excellence
NDE	nondestructive evaluation
NDI	nondestructive inspection
NEDT	noise-equivalent delta temperature
NEMO	Navy Earth-Map Observer
NEXRAD	Next-Generation Radar
NFPA	National Firefighter's Protection Agency
NHTSA	National Highway Traffic Safety Administration
NIAG	NATO Industrial Advisory Group
NIF	National Ignition Facility
NIH	National Institutes of Health
NIMA	National Imagery and Mapping Agency
NIOSH	National Institute of Occupational Safety and Health
N-ISDN	Narrowband Integrated Services Digital Network
NIST	National Institute of Standards and Technology
NLO	nonlinear optics
NLOS	Non-Lethal Operating System
NLW	Non-Lethal Weapons
NMD	national missile defense
nmi	nautical miles
NMR	nuclear magnetic resonance
NOAA	National Oceanic and Atmospheric Administration
NOE	nap of the Earth
NOMADS	Navy Ocean Model, Assimilation, Demonstration System
NOx	nitrous oxide
NPOESS	National Polar-Orbiting Environmental Satellite System
NPS	Naval Postgraduate School
NPTC	National Parachute Technology Council
NQR	nuclear quadrupole resonance
NRaD	NCCOSC Research and Development Division
NRDEC	Natick Research, Development, and Engineering Center
NRL	Naval Research Laboratory
Nrms	Newton root mean square
NRT	near-real time
NRTC	National Rotorcraft Technology Center
NSA	National Security Agency
NSF	National Science Foundation
NSS	Naval Simulation System
NSSN	next-generation nuclear attack submarine
NSTC	National Security Science and Technology Council
NSW	Naval Special Warfare
NTM	national technical means
NVD	night vision device
NVESD	Night Vision and Electronic Sensor Directorate
NVG	night vision goggle

O

O&M	operations and maintenance
O&S	operations and support
OASD	Office of the Assistant Secretary of Defense
OATSD(CBM)	Office of the Assistant to the Secretary of Defense for Chemical and Biological Matters
OCONUS	outside continental United States
OCR	operational capability requirement
OCSW	Objective Crew-Served Weapon
ODDR&E	Office of the Director, Defense Research and Engineering
ODS/S	Operation Desert Shield/Storm
OEIC	opto-electric integrated circuit
OICW	Objective Individual Combat Weapon
OMC	organic-matrix composite
OMCVD	organo-metallic chemical vapor deposition
OMG	Object Management Group
OMIC	opto-microwave integrated circuit
ONI	Office of Naval Intelligence

ONR	Office of Naval Research
OODBMS	object-oriented database management system
OOTR	operations other than war
OPSEC	operations security
OPW	objective personnel weapon
ORASIS	Orbital Read-Time Adaptive Spectral Identification System
ORB	Object Request Broker
ORSMC	Off-Route Smart Mine Clearance
OSD	Office of the Secretary of Defense
OSW	objective sniper weapon
OTH	over-the-horizon
OTM	on the move
OTV	orbit transfer vehicle
OUSD	Office of the Under Secretary of Defense

P

P^3I	preplanned product improvement
PAC-3	Patriot Advanced Capability 3
PACOM	Pacific Command
PASGT	Personal Armor System for Ground Troops
PASP	Photovoltaics Arrays for Space Power
PAT	Process Action Team
PBV	post-boost vehicle
PbMN	lead magnesium niobate
PC^2JTF	Portable Command and Control Joint Task Force
PCD	power, control, and distribution
PCI	peripheral component interface
PCMCIA	Personal Computer Memory Card International Association
PCS	Personal Communications System
P_d	probability of detection
PDA	planning and decision aid
PDE	pulse detonation engine
PDM	program decision memorandum
PDR	preliminary design review
PE	program element
PEBB	power electronic building block
PEGEM	Post-Engagement Ground Effects Model
PEO(USW)	Program Executive Office (Undersea Warfare)
PEP	propellants, explosives, and pyrotechnics
Pfa	probability of false alarm
PGM	precision-guided munition
PGMM	Precision-Guided Mortar Munitions
P_h	probability of hit
PHEMT	pseudomorphic high-electron mobility transistor
PI	product improvement
PIP	product improvement program
P_k	probability of kill
PLAID	position location and identification
PM	program manager; permanent magnet
PMAD	power management and distribution
PMD	program management directive
PMO	program management office
PNGV	Partnership for New Generation Vehicle
PNVG	panoramic night vision goggle
POC	point of contact
POET	Phase One Evaluation Team
POL	petroleum, oil, lubricants
POM	program objective memorandum
PP&T	personnel performance and training
PPU	power processing unit
PRCMRL	Precision Rapid Counter Multiple Rocket Launcher
PRG	Program Review Group
PROTEC	Programmable Ordnance Technology
PSA	pressure-swing adsorption (filtration technology)
psi	pounds per square inch
PSTS	Precision SIGINT Targeting System
PVDF	polyvinylidene fluoride

Q

QA	quality assurance

R

R&D	research and development
R&S	reconnaissance and surveillance
RAMICS	Rapid Airborne Mine Clearance System
RAP	radio access point
RASSP	Rapid Application-Specific Signal Processors/Processing
RBV	Rapid Battlefield Visualization
RCOE	Rotorcraft Center of Excellence
RCS	radar cross section
RCTA	reconfigurable control for tailless aircraft
RDA	research, development, and acquisition
RDEC	Research Development Engineering Center (U.S. Army CECOM)
RDT&E	research, development, test and evaluation
RECO	remote control
RESPO 21	Respiratory Protection System 21
RF	radio frequency
RFCM	radio frequency countermeasure
RFI	radio frequency interference
RFPI	Rapid Force Projection Initiative
RFPICC	Rapid Force Projection Initiative Command and Control
RHA	rolled homogenous armor
RHETT	Russian Hall Effect Thruster
RIBS	Rapidly Installed Breakwater System
RISTA II	Reconnaissance Infrared Surveillance Target Acquisition, Second Generation Technology II

RITA	Rotorcraft Industry Technology Association
RJ	ramjet
RL	U.S. Air Force Rome Laboratory
RLG	ring laser gyroscope
RLV	reusable launch vehicle
RMOP	Remote Minehunting Operational Prototype
rms	root mean square
RMS	Remote Minehunting System
ROE	rules of engagement
ROV	remotely operated vehicle
RPA	Rotorcraft Pilot's Associate
RS	Remote Sentry
RSM	radar signal modulation
RSTA	reconnaissance, surveillance, and target acquisition
RT	real time
RTIC	real-time information in the cockpit
RTOC	real-time information out of the cockpit
RTSMP	real-time symmetric multiprocessing
RV	reentry vehicle
RWST	Rotary-Wing Structures Technology
RWV	rotary-wing vehicle

S

s	second
S&A	safe and arm
S&C	selection and classification
S&T	science and technology
SA	situation awareness
SABER	Situation Awareness Beacon with Reply
SABRE	Shallow-Water Assault Breaching System
SADARM	seek-and-destroy armor
SADL	situation awareness datalink
SAM	surface-to-air missile
SAR	synthetic aperture radar
SAS	synthetic aperture sonar
SASMB	Side Attack Standoff Minefield Breacher
SATCOM	satellite communications
SAW	surface acoustic wave
Sb	antimony
SBD	simulation-based design
SBIR	small business innovation research; space-based infrared
SBIRS	Space-Based Infrared System
SBL	space-based laser
SBR	space-based radar
S/C	spacecraft
SC–21	Surface Combatant of the 21st Century
SCRJ	scramjet
SDTS	Self-Defense Test Ship
SDV	Swimmer delivery vehicle
SDWS	Submarine Defensive Warfare System
SE&BE	Sensors, Electronics, and Battlespace Environment
SEAD	suppression of enemy air defense
SEB	staphylococcal enterotoxin B
SEI	specific emitter identification
SENGAP	Small Engine Advanced Program
SEP	soldier enhancement program
SERAT	Structurally Embedded Reconfigurable Antenna Technology
SERB	Space Experiments Review Board
SERDP	Strategic Environmental Research and Development Program
SF/ISA	sensor fusion/integrated situation assessment
SFOR	Security Force
SFW	sensor-fused weapon
SHAPE	Supreme Headquarters Allied Powers Europe
SHARP	System-Oriented High-Range-Resolution Automatic Recognition Program
SHF	super high frequency
Si	silicon
SIA	Semiconductor Industry Association
SiC	silicon carbide
SiGe	silicon-germanium
SIGINT	signals intelligence
SIIRCM	suite of integrated IR countermeasures
SINCGARS	Single-Channel Ground and Airborne Radio System
SIP	system improvement program
SIRFC	suite of integrated RF countermeasures
SIT	static induction transistor
SL	sensor link
SLAM	Standoff Land Attack Missile
SLED	surface light emitting diode
SLEP	Service Life Extension Program
SLID	Small Low-Cost Interceptor Device
SLMM	Submarine-Launched Mobile Mine
SLR	side-looking radar
SLS	side-looking sonar
SM–2	Standard Missile 2
SMC	Space and Missile Systems Command
SMTD	submarine torpedo defense
SMTS	Space and Missile Tracking System
SNMP	simple network management protocol
SNR	signal-to-noise ratio
SOF	Special Operations Forces
SOI	silicon-on-insulation
SOJ	standoff jamming
SONET	synchronous optical network
SORTS	Status of Resources and Training System
SOS	silicon-on-silicon
SPC	Software Productivity Consortium
SPO	system program office
SPOD	surface point of debarkation
SR	surveillance and reconnaissance
SRAM	static random access memory

SRBOC	Super Rapid Blooming Off-Board Chaff
SRMU	solid-rocket motor upgrade
SSB	Small Smart Bomb
SSCN	Secure Survivable Communications Network
SSPDC	U.S. Army Space and Strategic Defense Command
SSP	Strategic Systems Program
SSTD	surface ship torpedo defense
SSTO	single-stage-to-orbit
STAFF	Smart Target Activated Fire and Forget
STAP	space-time adaptive processing
STIL	Streak Tube Imaging LIDAR
STO	short takeoff
STOW	Synthetic Theater of War
STP	Space Test Program
STRATCOM	Strategic Command
STRICOM	U.S. Army Simulation, Training, and Instrumentation Command
STS	sensor-to-shooter
SUO	small unit operations
SURVIAC	Survivability Vulnerability Information Analysis Center
SV	scout vehicle
SW	shallow water (200 to 40 ft)
SWIR	short wavelength infrared
SZ	surf zone

T

T&E	test and evaluation
TA	target acquisition
TAC	tactical
TACAIR	tactical aircraft
TACFIRE	tactical fire
TACLOG	tactical logistics
TACOM	U.S. Army Tank-Automotive Command
TAFT	Today's Aircraft Flying Tomorrow
TALD	Tactical Air-Launched Decoy
TAMPS	Tactical Aircraft Mission Planning System
TAPSTEM	Training and Personnel Systems Science and Technology Evaluation Management
TARA	Technology Area Review and Assessment
TARDEC	U.S. Army Tank-Automotive Research Development and Engineering Center
TBD	to be determined
TBM	theater ballistic missile; tactical ballistic missile
TC AIMS	Transportation Coordinator, Automated Information Management System
TCLP	Toxicity Characteristic Leaching Procedure
TCP	Transmission Control Protocol
TD	technology demonstration
TDA	tactical decision aid; Technology Development Approach
TDD	target detection device
TDP	technical data package
TEED	Tactical End-to-End Encryption Device
TEL	transportable erectable launcher
TEM	Terrain Evaluation Module
TEMO	training exercises and military operations
TENCAP	tactical exploitation of national capabilities
TES	threatened and endangered species
TF	task force
TF/TJ	turbofan/turbojet (an engine classification)
TFLOP	tera-floating point operations
TFSOS	thin-film, silicon-on-sapphire
TFXXI	(U.S. Army) Task Force Twenty-One
THAAD	Theater High-Altitude Air Defense
THEL	Tactical High-Energy Laser
Ti	titanium
TLAM	Tomahawk Land Attack Missile
TLCP	toxicity characteristic leaching procedure
TMD	theater missile defense
TMET	transonic missile engagement target
TMG	Tactical Multinet Gateway
TO	theater of operation
TOA	time of arrival
TOC	tactical operations center
TOGW	takeoff gross weight
TOTA	thin-optical towed array
TOW	Tube-Launched Optically Guided Weapon
TPEDIT	Time-Phase Force Deployment Data Editor
T/R	transmit/receive
TRADOC	U.S. Army Training and Doctrine Command
TRANSCOM	U.S. Army Transportation Command
TREE	transient radiation effects on electronics
TRP	Technology Reinvestment Project
TSA	temperature-swing adsorption
TS/TP	turboshaft/turboprop (an engine classification)
TT&C	telemetry, tracking, and control
TTCP	The Technical Cooperation Program
TTP	tactics, techniques, and procedures
TUAV	tactical unmanned aerial vehicle
TVC	thrust vector control
TVSS	toroidal-volume search sonar
TWMP	Track Width Mine Plow
TWMR	Track Width Mine Roller
TWS	thermal weapons sight
TWT	traveling wave tube

U

U.K.	United Kingdom
UAV	unmanned aerial vehicle
UDP	User Datagram Protocol
UFO	UHF follow-on
UGS	unattended ground sensor
UGV	unattended ground vehicle
UHF	ultra high frequency
UJTL	Universal Joint Task List
US/OTV	upper stage/orbital transfer vehicle
USCAR	U.S. Council for Automotive Research
USDA	U.S. Department of Agriculture
USER	Ultra Small Electronics Research
USGS	U.S. Geological Survey
USMC	U.S. Marine Corps
USMTF	U.S. message text format
USSOCOM	U.S. Special Operations Command
USSPACECOM	U.S. Space Command
USW	undersea warfare
UTD	Unmanned Terrain Domination
UUV	unmanned underwater vehicle
UV	ultraviolet
UWB	ultra wideband
UXO	unexploded ordnance

V

VCATS	Visually Coupled Acquisition and Targeting System
V	volts
VE	virtual environment
VEE	Venezuelan equine encephalitis
VFDR	variable flow ducted rocket
VHDL	VHSIC hardware description language
VHF	very high frequency
VHR	very high resolution
VHSIC	very high speed integrated circuit
VISTA	Variable In-Flight Simulator and Test Aircraft
VLSI	very large scale integrated
VLSTRACK	Vapor, Liquid, and Solid Tracking model
VLWIR	very long wavelength infrared
VMF	variable message format
VMMD	vehicle-mounted mine detector
VOC	volatile organic compound
VP	virtual prototyping
VR	virtual reality
VSTOL	vertical/short takeoff and landing
VSW	very shallow water (40 to 10 ft)
VV	verification and validation
VV&A	verification, validation, and accreditation
VV&C	verification, validation, and certification

W

W	watts
WAM	wide area munition
WARSIM 2000	Warrior Simulation for year 2000
WAS	wide area surveillance
WATS	wide area tracking system
WAVES	Waveform and Vector Exchange Standard
WCM	wired-cored matrix
WEE	Western equine encephalitis
WES	Waterways Experiment Station
WF–1	Warfighter–1
WFA	warfighter's associate
WFD	widespread fatigue damage
WGE	Working Group of Experts
Wh	watthours
Wh/kg	watthours per kilogram
WINGS	wireless Internet gateways
WL/V	weapon lethality/vulnerability
WMD	weapons of mass destruction
WORM	write once–read many
WP&S	warrior protection and sustainment
WPAFB	Wright-Patterson Air Force Base
WSC	Warfighting Support Center

X

XVIII ABC	18th Airborne Corps

Z

$ZnGeAs_2$	zinc germanium arsenide